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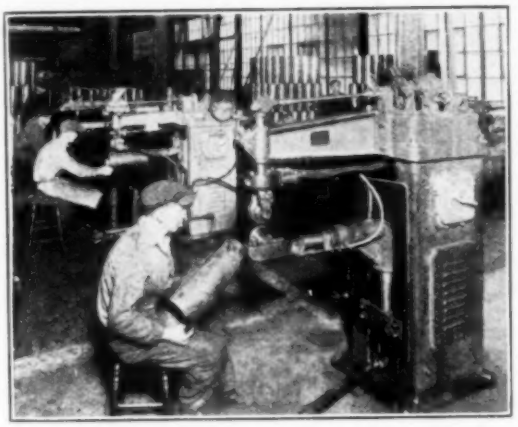
Castings Give Service When Metals Are Welded

THE forge process of welding metals, such as now is employed by the blacksmith, originated among the ancients who first worked metals. For centuries, men were content with this method of joining metals and confined their efforts to improvements in technic. However, great progress has been made in recent years toward the development of the fusion method of welding. In this process, both ferrous



The Spot Welding Machine Occupies An Important Place in Many Lines of Manufacture

and nonferrous metals are joined at high temperatures without the application of pressure or blows from the hammer. Today, every metal-working industry offers a potential application for some form of welding. This method of joining metals advanced the work of the navy department considerably during the war. Experiments now are being conducted to determine the practicability of welding and structural shapes in the modern steel frame skyscraper. Castings are being repaired, pipe lines constructed, machinery kept in commission and hundreds of articles manufactured through the application of welding. Where spot welding operations are employed in the fabrication of steel, and in portable electric welding machines, castings form an important part of the apparatus.

Find Where Castings May Be Sold

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Fig. 1—As mentioned by Mr. Simonds in THE FOUNDRY *for Dec. 1, 1924, an area of reclaimed land was built by depositing waste material in the bay. The stock yard now occupies this made land*

Expands Business by B

Nineteenth Century Firm Renews Le f Life Under New Organization—How Val nd Fi

By Pat Dwyer

BETWEEN the years 1908 and 1912 keen competition temporarily halted the growth of the Walworth Co., Boston, and elsewhere, while a search was made for a Moses to show a path out of the wilderness. Manufacturing and sales methods had been developed to a high state of efficiency as a result of nearly 70 years' experience. The sales organization usually had kept manfully ahead all these years. In supplying old and in opening new markets at home and abroad it acted as a constant spur to the factory organization to increase production.

However, as in the case of all contests, the race is not over until it is finished. In the years mentioned production gradually crept up on sales. Soon the pair were running side by side and eventually production began to draw ahead. Then the directors decided it was about time to go into serious and earnest conference.

Coming down to bed rock they found they had a choice of two alternatives. They might either throttle down on the volume of production at the source, or increase the number and size of the outlets. The first was opposed to every policy and tradition of an establishment with such a long history of constant growth and expansion.

Theoretically the second alternative seemed to present the logical solution. The only objection to it was that competitors held all the gates to the promised land with the exception of those held by the company and these were not sufficient either in number or capacity to take care of the output from the plant.

At this interesting stage, Howard Coonly, a young business man of Chicago was induced to accept the presidency of the company in 1912. He looked over the entire situation and discovered that many gates used by others were not taxed nearly to capacity. He decided to divert some of the excess traffic through these gates. To insure frictionless operation he acquired complete control of the gates and the avenues leading thereto before he began shooting the Walworth products through them. He placed Theodore W. Little in charge of production and W. P. Ayer in charges of sales and thus equipped he reached out, acquired other plants here and there and established new distributing branches.

Production of the company was trebled in 1917 by the acquisition of the United States Steel Corp. factory at Kewanee, Ill. The Joseph E. Gallagher Co., New York, became a New York branch. A new and complete branch was built in Chicago. An outlet to the Pacific northwest was secured through the purchase of the property of the A. Hambach Co., Seattle. Between 1919 and 1925 the company established branches in Philadelphia, Buffalo, Erie, Cleveland, Youngstown and London.

During the year 1925 the Mach Lally Co. of California with six branches on the Pacific coast was taken over. In July of the same year the National Pipe & Foundry Co., Attala, Ala., was absorbed, followed in October by the Kelly-Jones Co., Greensburg, Pa. Acquisition of this last named company brought four large and well equipped branches, Pittsburgh, Cincinnati, Chicago and San Francisco.

In view of the foregoing and even allowing for the natural enthusiasm of the inventor, the most enthusiastic of all brands of enthusiasm, it is quite safe to assume that when James Jones Walworth in the early forties first tried out his invention of heating buildings with steam, he had no conception of the giant which, like the fisherman in the fable, he was releasing from the bottle. He first removed the cork in a little one room place at 38 Ann street, New York city, where in partnership with Jo-

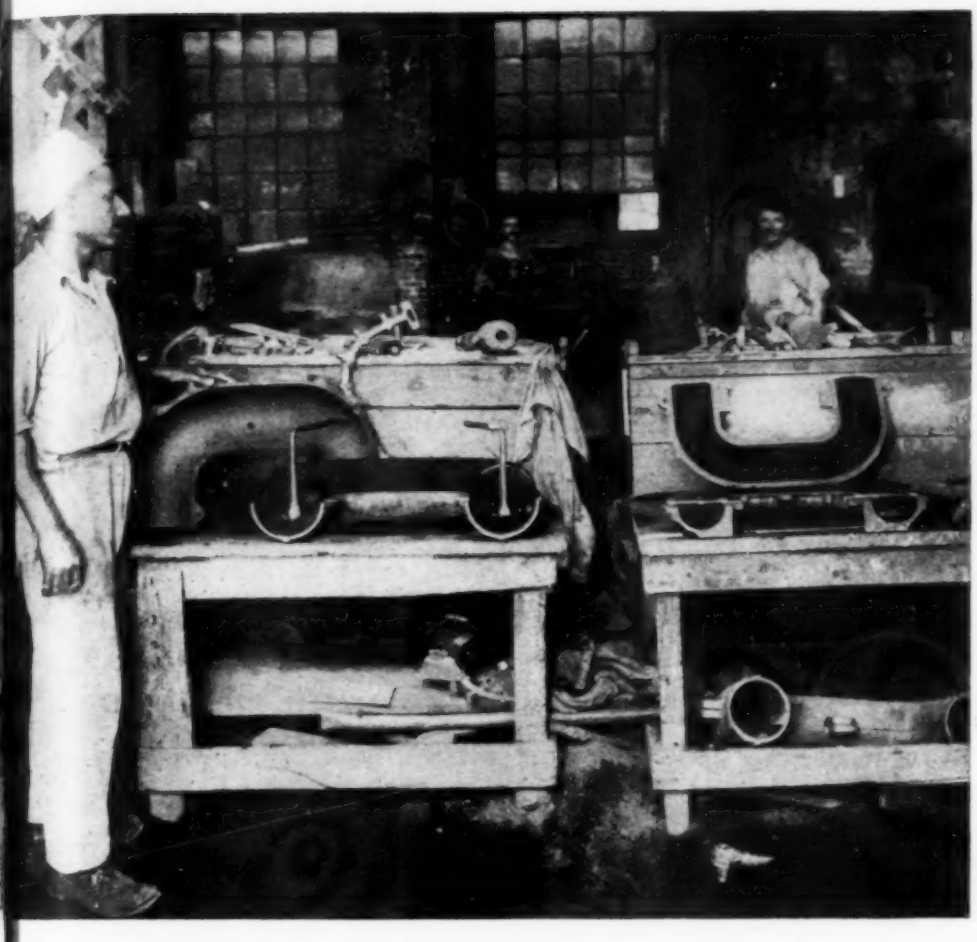


Fig. 2—Green sand cores for special and standard pipe fittings are arranged so that no chaplets are required. In the examples shown each complete core serves a pair of castings

Building New Outlets

Life and Reclaims Lost Ground
nd Fittings Are Made in Eastern Shop

seph Nason he proposed to engage in the business of building and installing the new heating device in residences and places of business. That was in 1841, a fairly remote period as reckoned in the American manufacturing industry.

Extent to which the giant has expanded since that time may be compared to the example in the *Arabian Nights*, with the single exception that the giant is benevolent and still is growing and constantly covering more territory. The business has had its inevitable lean years in such a long period of existence, but though the growth has been retarded at times it developed more vigorously than ever each time after a setback.

Lack of room and perhaps other reasons led the partners in 1842 to move to the Boston district where a small plant was established at Edgeworth near Malden. In 1844 the firm received its first sizable contract for heating a woolen mill with steam. The installation was a success and paved the way for a steadily increasing volume of new business. Joseph Nason withdrew from the partnership in 1852 and returned to New York where he went into business for himself. J. J. Walworth formed a new partnership with his brother, C. C. Walworth and M. S. Scudder.

In 1858 the original plant was abandoned for a newer and larger one in Cambridgeport and a sales room and office were opened in Boston. The firm experienced all the trials and tribulations common to the years of the Civil war and afterward while the country was going through a reconstruction period. C. C. Walworth was the guiding spirit by this time and though the business was somewhat bruised and battered from the heavy pounding to which it had been subjected during these trying years, still he managed to keep it on its feet until the final gong announced the close of the fight.

A new but related field was entered in 1869 when the company began the manufacture of the famous pipe wrench named after the inventor Daniel Stillson one of the original Walworth master craftsmen. In an almost infinite variety of sizes this item still constitutes one of the main exports from the Boston works. For many years the castings were made in an exceptionally well-equipped malleable foundry at this plant, but recently owing to economic conditions and the acquisition of other manufacturing plants elsewhere, the malleable castings are made outside, shipped to Boston and assembled there.

Eighteen seventy-two was a most memorable year in the history of the company. In April of that year it was incorporated as the Walworth Mfg. Co., with J. J. Walworth president; M. S. Scudder vice president; C. C. Walworth manager of the mechanical department. J. W. Allen and E. C. Hammer also signed the articles of incorporation and the five men became the original board of directors. In November of the same year it was almost swept out of existence by what is known as the great Boston fire, to distinguish this particular fire from many others which at one time or another have scourged the city, but failed to straighten it out. Insurance policies at that time were not the gilt edged securities they have become since. The Walworth company like many other fire victims got nothing.

The South Boston property was bought in 1881 and a beginning was made in the erection of the extensive group of buildings which house the activities of the Boston works at present. These include a pipe bending shop, a brass foundry, a malleable foundry at present being converted to other use, a gray iron foundry, a forge shop and a group of machine shops, besides the auxiliary departments, finishing, assembling, painting,

Fig. 3—Dry sand cores first are made in halves and dried and then the halves are pasted together

shipping etc., connected with these various main departments. The present description will be confined to features of interest in the gray iron foundry. The brass foundry will be described in a future issue.

Property on which the plant is built has been expanded to a considerable extent by the reclamation of a large area that was under water when the property was acquired. The greater part of the stock yard has been built up in this manner. It is shown in the center of the illustration Fig. 1 with part of the government owned Commonwealth pier in the back ground. Several years ago the reclaimed area became sufficient to serve all the needs of a storage yard and since that time all dumping has been confined to refuse from the various departments, principally from the foundries.

For this purpose it will last practically indefinitely. The water in this one of the many indentations comprising Boston harbor is quite deep. Also the ebb and flow of the tide has a tendency to wash the material away from the bottom of the fill and distribute it over the bottom of the channel for a considerable distance from the dumping point. The narrow gage track leading to the dumping point terminates in a short semicircular platform mounted on pontoons and protected by a pipe railing as shown at *A* in Fig. 1. When the open space inside the semicircle is filled the floating platform is moved outward and again connected to the narrow gage railroad by short sections of track.

Freight is received and shipped from this yard both by rail and water. Local shunting around the yard is done by a locomotive crane which also unloads and loads a great deal of bulk material too heavy to be handled by hand, by wheelbarrows or by industrial truck either of the gasoline or storage battery type. The company is a strong supporter of the safety first movement and to that end insists on order, neatness and system in all departments including the yard shown in Fig. 1 where there is a place for everything and everything is kept in its place. None of the foundries is shown in this picture which was taken from the fourth story of the brass foundry building. Incidentally it may be mentioned that the gray iron foundry is to the extreme right and the malleable foundry and forge shops are in the center of the group.

The gray iron foundry of brick and steel construction conforms in general features to what has come to be recognized as standard. It is divided into three main bays by two rows of steel columns that support the crane runway in the central bay and

Fig. 5—Iron for the side floors is delivered on a monorail and poured by special men delegated for the purpose

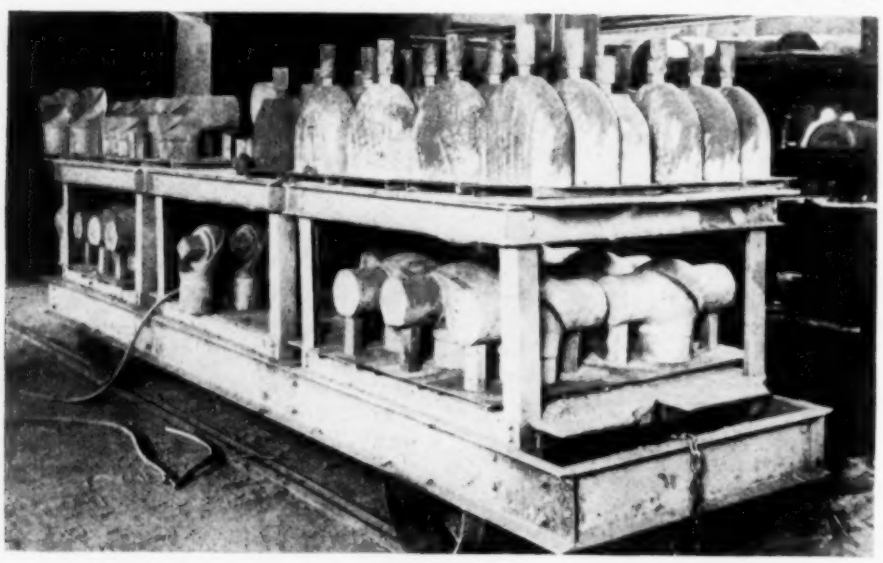


Fig. 4—Wood props support the ends of the globe valve cores until the paste has dried

the high roof over the same bay. A continuous window occupies the space on each side between the eaves of the high central roof and the roof over each of the side bays. These windows furnish the main sources of light, but they are supplemented by additional windows in the side and one end wall of the building and by a row of electric lights suspended from the roof at a point sufficiently high to clear the crane bridges.

One end of the building across all three bays is occupied by the core making department. A similar and even larger space at the opposite end of the building is devoted to cleaning the castings. Molds are made over the remainder of the floor space with the exception of a space approximately 60 feet in length in front of the two cupolas in one side bay and a space of approximately the same dimension in the opposite bay which has been enclosed to serve as a sand storage. The locomotive crane, equipped with a grab bucket, unloads the sand from cars on the siding and drops it through suitable hatches in the roof of the sand storage. Here it always is kept in good condition and is quite close to a 6-foot mixer made by the National Engineering Co., Chicago, in which facing sand and core mixtures are prepared. The mixer is equipped with a loading device in which the various ingredients are assembled in proper proportion and quantity before they are placed in the mixing pan.

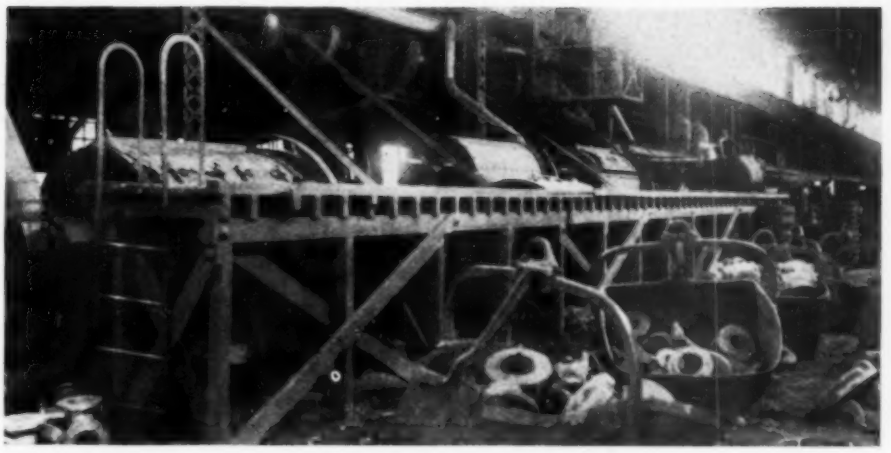


Fig. 7—Trip buckets are employed for conveying the castings from the molding floors to the tumbling barrels

Small cores are made from an oil sand mixture, but the larger cores are bonded with a dry binder. Sharp sand exclusively is used in the small cores. Varying proportions of sharp sand and bank sand are used in the larger cores. Old sand is used extensively as one of the ingredients in the largest cores. The relative proportions of various sands in the mixture depends on several factors, principally the size and shape of the core, the area covered with metal and the facilities provided for the escape of the gas. For example, the cores shown in Fig. 4 are made from a 2 to 1 mixture of sharp and bank sand while in the cores shown in Fig. 3 old sand has been substituted for bank sand. In the largest size a facing of half sharp

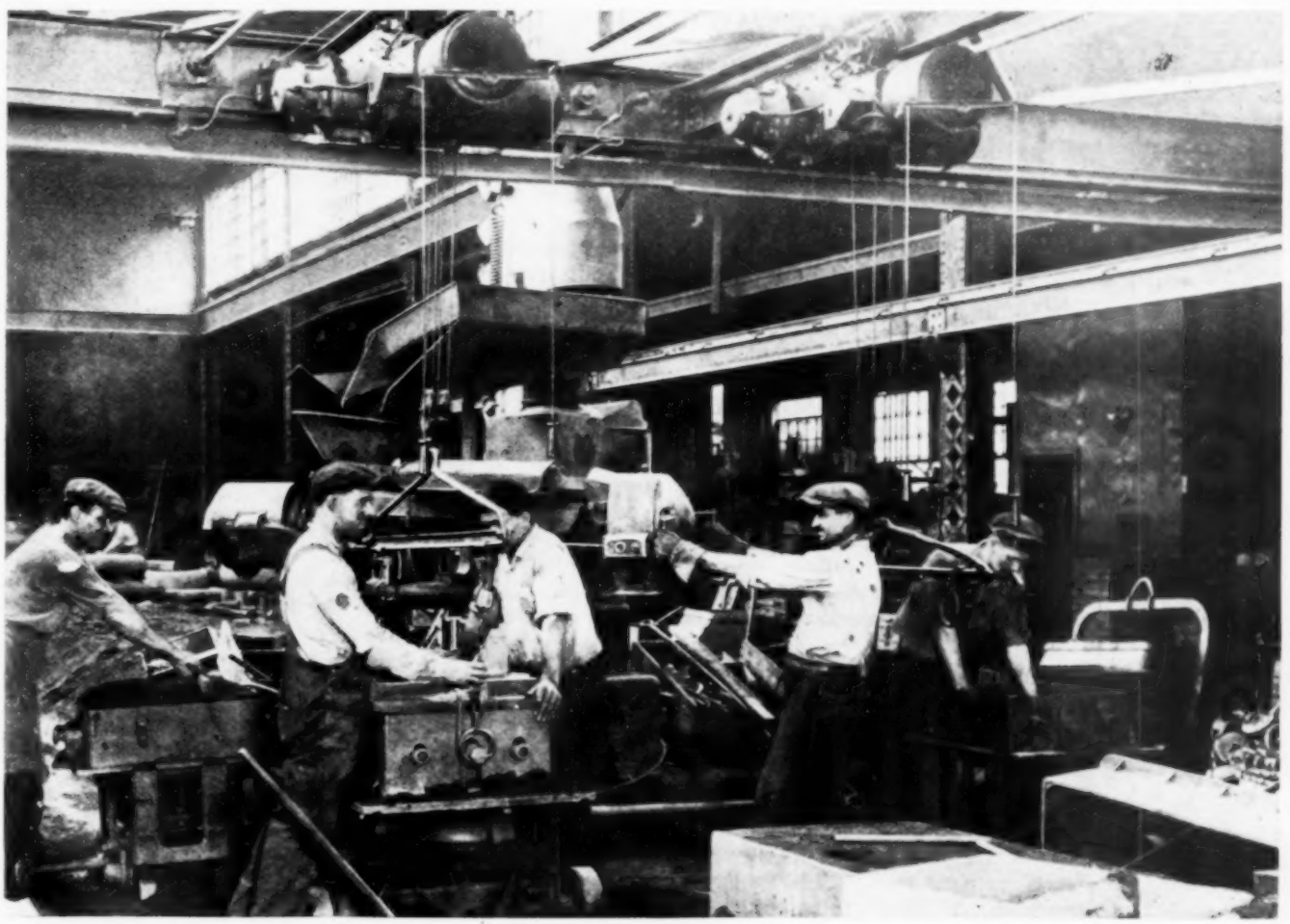


Fig. 6—Pattern stripping machines are attached to the sand throwing machine and travel with it

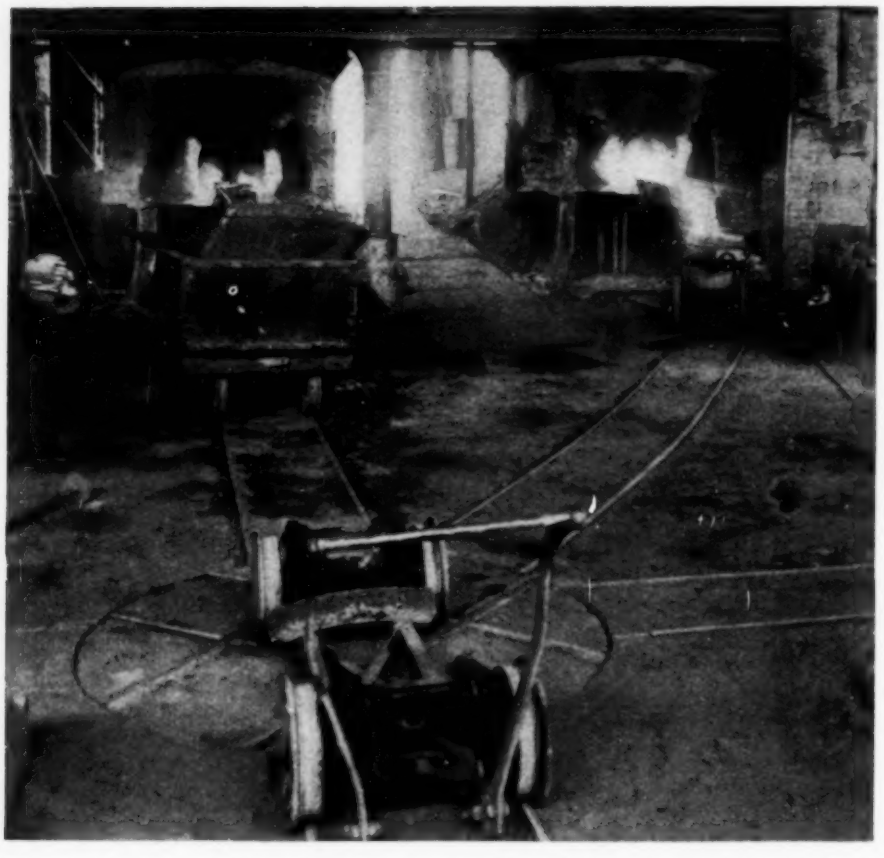


Fig. 8—An industrial track and turntable facilitate the movement of molten iron to various parts of the foundry. Each of the cupolas is used on alternate days

and half old sand is rammed against the face of the corebox. The inside of the core is packed full of old sand. These cores are made and dried in halves and afterward pasted together.

Two large ovens and three smaller ovens are provided for drying the cores. The two large ovens, one 10 x 10 x 15 and the other 10 x 15 x 15 are equipped with cars of the type shown in Fig. 4 and in the left back ground Fig. 3 which may be built up to any desired height by a series of temporary shelves. Each of the three small ovens is equipped with a vertical spindle and a number of circular shelves which may be rotated. Coke is used for fuel in all the ovens.

Flasks Without Bars

In accordance with almost universal practice where various classes of castings are made, the smaller castings are molded in the two side bays while the central bay is reserved for medium and heavy weight castings. Machines made by the International Molding Machine Co., Chicago, are provided for making the small molds. Some of the larger molds are rammed by hand. A considerable section of the central bay is served by a sand throwing machine made by Beardsley & Piper Co., Chicago, on which nearly all the medium size castings are molded.

Split patterns for pipe fittings are mounted on four stripping plate machines which in turn are mounted on wheels and moored to the sand throwing machine by suitable lengths of chain. The machine is of the tractor type and as it travels over the sand pile it takes the machines and patterns with it. A specially built crane with two small hoists made by the Shepard Crane & Hoist Co., Montour Falls, N. Y., travels with the machine and handles the flasks. General features of the installation are shown in Fig. 6.

Flasks are provided with sand strips around the inside of the joint edge, but except in a few instances carry bars neither in the cope nor drag. The bottom board prevents the sand from falling out of the drag when it is rolled over. A length of 2-inch plank from 4 to 6 inches wide prevents the sand in the cope from pushing up under the pressure of the metal. The ends of the plank are secured by the same clamps employed to hold cope and drag of the mold together. These open flasks are rammed more readily and shaken out much more easily than flasks containing a net work of close fitting bars.

The sand throwing machine is used to ram a great many molds in addition to those made on the machines which are towed in its wake. A pattern, bottom board and drag may be assembled at any point in the central bay. The unit is picked up by any one of the three 7½-ton traveling cranes made by the Northern Engineering Works, Detroit, which span the main bay, and lowered at any clear space within the scope of the swinging head on the sand thrower. After it has been rammed full of sand the flask is removed and handled subsequently in a routine manner. Owing to the fact that a great many of the patterns are symmetrical, the copes and drags of the molds may be rammed independently of each other.

Use Green Sand Cores

Green sand cores are employed extensively on many of the standard fittings. Equipment and method for making 5 and 6-inch 90 degree elbow cores in pairs are shown in Fig. 2. The iron shell corebox is in two parts. A light, cast-iron arbor furnishes all the support required by the entire core. In practice a small quantity of sand is pressed into the lower half of the corebox. The clay washed arbor is pressed down into place and the remainder of the half box is filled with sand, rammed lightly and scraped off flush with the joint. The second half of the corebox then is rammed full of sand and also scraped off flush. The two halves of the box then are raised to a horizontal position face to face after which the entire unit is lowered back on the bench with the half box containing the arbor underneath. The top half of the box is lifted off and then the core is lifted out of the lower half of the box by the pair of special lever handles shown attached to the core on the left in Fig. 2. The arbors do not fit the coreboxes closely and therefore may be removed readily from the 90-degree elbow castings later.

Two cupolas lined to 40 inches and made by the J. W. Paxson Co., Philadelphia, are used for melting the daily heat which varies between 40 and 50 tons. Each cupola is in blast practically all day and for that reason they are used altenately. Charges are made up in the proportion of 125 pounds coke to 1000 pounds of iron. The analysis of the charge varies depending on the size of the casting, the thickness of metal section and the pressure to which the casting is to be subjected in service. Steel scrap is added sparingly. The usual amount is 5 per cent for low and 12½ per cent for high pressure castings.

Castings are shaken out as soon as possible after they are poured and carried to the cleaning room end of

(*Concluded on Page* 72)

What Does a Buyer Want *in Malleable Cast Iron?*

By H. A. Schwartz

SINCE 1904 the tensile strength of malleable castings, as measured by the American Society of Testing Materials specifications, has increased from 40,000 pounds per square inch to 50,000 pounds per square inch, and the elongation from 5 per cent to 10 per cent. These changes were in large part motivated from within the malleable foundries, and it may be doubted whether the consuming interests did more than acquiesce in the acceptance of a superior material.

The economic desirability of these changes, irrespective of their cause, may be measured by the degree in which they increased the application of this product in the industries, or permitted a reduction in weight and hence of total cost of existing malleable articles. The author is not disposed to admit on *a priori* grounds that such economies did necessarily follow.

The inarticulateness of the consuming interests in this regard is regrettable, for a clear recognition by consumer and producer alike, of what properties are desired in a given product, is the first necessity of a satisfactory relationship. Sooner or later, the user's requirements find expression in the form of specifications, formally or tacitly understood, under which he orders, and accepts material.

It would seem axiomatic that no requirement should be so incorporated which does not raise the useful value of the material more than its cost, for otherwise the product will, deservedly or not, fall into disuse.

It seems equally self-evident that only such requirements should be included as are necessary, and sufficient for the description of the properties for which the material is used. Additional needless limitations increase cost without increasing value, and so violate the first principle laid down. Furthermore, it will be agreed, that any tests applied should measure, so far as possible, directly, the actual properties for which the material is valued, and that indirect tests should be employed only when accurately reproducible methods exist for direct measurement of the various properties.

INTEREST in the marketing and distributing phases of the malleable iron industry was aroused in this paper on the requirements of malleable iron, presented at the Detroit meeting of the American Foundrymen's association, Sept. 27-Oct. 1.

H. A. Schwartz, the author, was born in Oldham Co., Kentucky, in 1880 and was graduated from Rose Polytechnic institute, Terre Haute, Ind., in 1901, receiving the degree of bachelor of science. In 1903 he received the degree of master of science and the degree of mechanical engineer in 1905. He was an instructor at Rose Polytechnic institute in 1901 and 1902 and from 1902 to 1920 was connected with the Indianapolis works of the National Malleable Castings Co. as draftsman, chemist, metallurgist and assistant superintendent. In 1918 he was made metallurgist and assistant superintendent and in 1918 was promoted to metallurgical engineer for the entire corporation with an office at Indianapolis. From 1920 to date has been manager of research at the National Malleable & Steel Castings Co., Cleveland. He is a member of American Society for Steel Treating, being chairman of the Cleveland chapter 1924-25, and 1925-26; American Institute of Mining & Metallurgical Engineers; American Foundrymen's association; American Society for Testing Materials (Committee E-4), Society of Automotive Engineers, and Iron and Steel institute (British). He is the author of "American Malleable Cast Iron," published by Penton Publishing Co. in 1922, and many technical papers. He also is a special lecturer at Case School of Applied Science, Cleveland, in metallurgy of cast iron.

H. A. Schwartz

It will be readily granted that the calculation of the stresses in even a relatively simple casting, and under the simplest of load conditions, is beyond the limits of our present engineering knowledge. Consequently, no engineer is able to define upon a purely academic basis just what requirements will fit a theoretical material for an intended use.

Specifications can not, and should not be set up upon such a foundation. Their requirements are properly to be interpreted as a statement of the quality of a material known by experience to satisfactorily serve its purpose. They then serve as a means of determining whether other lots, purporting to be identical, are of equal quality.

What the Consumer Desires

Malleable castings are articles of manufacture because they possess a combination of strength, ductility, impact and fatigue resistance and machinability, which renders them more useful, cost considered, for certain purposes than their possible substitutes. With certain specialties as exceptions, the consumer desires to buy for a dollar the most he can get of each of these properties.

In what terms shall he describe his wants in order that, upon closing a contract, he may be assured that his minimum expectations will be realized?

He requires assurance that:

The metal, as cast, is of a quality yielding satisfactory physical properties upon anneal.

That each casting is completely annealed.

That each casting is sufficiently sound, mechanically.

From the base fundamentals of malleable metallurgy, these three factors are entirely separate and distinct.

The first is a question involving the individual melting furnace heat as a unit.

The second involves the annealing furnace heat as a unit, and implies a knowledge of the uniformity of heat treatment, throughout a given furnace. This is, perhaps, obtainable only by

inspection of each individual casting.

The third factor is not a question of metallurgy, or properties of materials, but of foundry practice.

The logical manner of controlling the first variable is by suitable mechanical tests, on a properly annealed specimen from each heat. The second by visual inspection of test lugs from each casting, if these be of fair size. The third by inspection of broken castings, or perhaps, in extremely critical cases, by X-ray examination of finished castings.

It is to be remembered that the form and preparation of the test specimen is just as much an essential of a specification as the required values of the physical constants to be measured. Test specimens are purposely prescribed of forms which can be produced with the greatest freedom from mechanical defects. The purpose is to eliminate as variables, all factors except the quality of the metal.

It is not implied in any specification that specimens cut in various ways from masses of material shall be expected to conform to the same standards. With the exception of rolled rods of small cross section, where, from the nature of the case, specimens can be produced with only one location and orientation with respect to the material, it will never be found that the strength of a metallic test bar is independent of the size and location of the test specimen in relation to the object from which it was cut.

How Shall Consumer Describe the Metal Desired?

The consumer who cuts a specimen from a casting and finds its properties inferior to the requirements of a specification such as that of the A. S. T. M. has not necessarily any cause for complaint, as to the properties of the metal. He may have legitimate grounds for objecting to the soundness, or integrity, of the casting if a harmful shrink is disclosed as the cause of failure, or it may be that the casting is of such size and form that the unit stresses to be expected in the normal specimen can not be equalled. A lack of understanding of these principles is a frequent cause of unjustifiable complaints by the consuming interests.

It is wisely permitted by the present standard specifications that metal rejected as apparently "under-annealed" may be reheat-treated. This follows quite logically from the fact that the metallurgy of the product is a two stage process. While there exist certain broad and definite general relations between the two steps, it would be manifestly unfair to condemn the entire material for a remediable error in the second of the two steps.

We are now confronted with the major question of this paper. In what terms shall the consumer describe the metal of which his castings are made, in order that he will secure the most economical combination of the previously enumerated desiderata at reasonable cost and in reasonable time?

It seems self-evident that the use of chemical specifications for a material of engineering construction is not justifiable where the desired properties can be measured and defined. Excluding the limited applications of ferrous material under circumstances where their chemical behavior determines their suitability for an intended use, there seems little reason for writing a chemical specification. With only a few exceptions, probably fewer than usually realized, the properties demanded of a metal can be accurately described in physical rather than chemical terms.

Physical or Chemical Test; Which Is Better?

IT IS the author's carefully considered judgment that there is no defect in the metallurgy of malleable cast iron, against which the consuming interests can not more adequately guard themselves by physical rather than chemical requirements.

Chemical composition is the chief corner stone of works' control, and a knowledge of the chemistry of his processes and products the most useful guide at the command of the producer. The consumer, however, being of necessity not a specialist in any given raw material, is less likely to be sufficiently informed along these lines.
—H. A. SCHWARTZ.

Importance of Physical Requirements

Chemical specifications often are generally meaningless. For example, prewar specifications for steel products commonly set a maximum sulphur content of 0.05 of a per cent. Extended investigation, motivated by war necessities, has failed to disclose, for most purposes, any decided superiority of such material over an otherwise correct metal containing 0.06 per cent sulphur. Why then, should the nation's industries be burdened with the expense involved in a reduction of the sulphur to the lower limit?

A large and highly reputable automobile manufacturuer has included in his specifications for malleable castings, a *minimum* carbon content. It is known to all of us that the strength and ductility of malleable cast iron vary inversely as the carbon content. Leaving aside the fact that the consumer's *minimum* value comes perilously close to making it impossible to secure his requirements with respect to tensile strength, his chemical requirement operates to reduce the quality of material which may be furnished him under his specifications, by limiting the quality of material which is admissible thereunder.

We are left, with the opportunity of describing quantitatively the physical properties required in a casting. Theoretically, it should be possible to describe, in quantitative terms, all the properties desired in the material to be used for a given purpose. Practically, this is but a vision and far beyond the limitations set by our present engineering knowledge, both with respect to testing, and design.

Even if sufficient knowledge were secured, the execution of a multiplicity of tests would be so wasteful of time and money as to be economically unsound. The problem is then to select one, or at most, a few tests, simple and accurate of execution, which may be considered a measure of conformity of the product to an established standard. The tensile properties of materials have come to be adapted quite generally for this purpose, largely because of the relative simplicity of their determination.

Fatigue And Impact Tests

Many engineers have expressed themselves as being uninterested in the tensile strength of the metal in the malleable castings they buy. Strictly speaking, this attitude is justifiable, although they probably are interested in many other properties which are found in metal of satisfactory tensile properties. It is however, incontrovertible that tests regarding the behavior of malleable castings under fatigue or impact would form a much more direct measure of the materials' utility than do static tension tests. The same may be said of any other materials to be used in machine parts or elsewhere, under conditions of variable load.

Tests of this character have not, as yet, been standardized sufficiently to commend them generally as a basis for the acceptance or rejection of a material. They may, however, be expected to grow in favor as they become better understood. It is by no means unlikely that some form of

impact test, such as the Charpy, may come into more extended use for various materials in the future.

The Walker wedge test, constituted an attempt in this general direction. It found but little permanent favor because it became evident that the test was not strictly reproducible. This is a criticism of this particular form of test, and of the apparatus for its execution. A sufficiently simple impact test, capable of accurate reproduction, might prove to have great utility.

Cross bending tests, once demanded by the standard specifications, have been quite wisely omitted in recent years in this country. They had proved superfluous, since all metal capable of passing the then existing tensile requirements passed them so easily that those tests added nothing to the user's knowledge of his material. With characteristic practicality the British still require, on white heart malleable, a bending test as a measure of the deformation the material will undergo, and not as a strength test.

Tensile tests required on malleable, so far, have included only a requirement for ultimate strength and elongation. They are certainly as good measures of this material's fitness for an intended use, as of the utility of a steel casting or forging. Whether or not the values now set for these constants, namely 50,000 pounds per square inch and 10 per cent elongation, are the most desirable remains an open question.

An increased strength requirement, accompanied by a suitably increased elongation, certainly will be accompanied by an increased resistance to fatigue and impact. It will be shown later, that where machinability is important, a balance must be struck between the value of strength and ease of cutting, and an indefinite increase in strength is, therefore, not necessarily in the user's interest.

New Demand Arises

During the last year or two there has come, from some sources, a demand for the inclusion of a figure for yield point in the tensile specification. The demand has behind it a measure of logic, since most ferrous materials are being specified from this viewpoint, or at least have been studied by engineers sufficiently, so that the user is satisfied that he can rely upon a given yield point from a known kind of material, of given tensile strength. It is obvious also that the yield point rather than the tensile strength is the limiting factor in the design of static structures at least, while the fatigue limit is the true criterion under dynamic conditions. Fortunately, the latter is almost uniformly 50 per cent of the ultimate strength in all ferrous materials so far tested. It was, therefore, inevitable that the user should demand either a guaranteed yield point, or at any rate, some definite assurance of the relation of yield point to ultimate strength.

As a mere expression of the author's opinion, it may be here stated that the yield point of malleable cast iron is certainly above 60 per cent of its ultimate strength.

Its exact location may well be a subject for argument to a much greater degree than in the case of competitive materials. Having recently made a critical study of data from seven laboratories, including two consumers, one consultant, and four producers, the author has been shown conclusively that different experimenters will vary as much as 4000 pounds per square inch or about 12½ per cent of the mean value, in the average results of long series of tests for this constant on metal of equal quality. Such a lack of agreement is disquieting.

At present, the yield point is frequently defined as the point where "the beam drops" in testing. The incongruous data already alluded to, were obtained in this way. In the author's judgment, this method has little but simplicity in its favor. The reason for the nonconcordant results are as follows:

1. The absence of any point at which stress does not increase at all with the strain renders the point indefinite, per se.
2. The specimen, being unmachined, is not of uniform cross section throughout its length, hence different zones reach the yield point at different times, and render the point even vaguer.
3. The specimen, being held by wedge grips, is not located definitely with respect to the cross heads of the machine and slips in the holding mechanism may confuse the yield point or be mistaken for it.
4. The specimen, never being perfectly straight, introduces similar errors.

Malleable cast iron is used for some purposes which never stress it anywhere near its safe limit simply because it is the most machinable commercial ferrous material possessing any useful degree of ductility. A consumer of castings of this type will not find his interests served by any increase in the specified strength requirements.

Machinability requirements at least are implied in many agreements, and consumers consider themselves justified in rejecting material defective from this viewpoint. Unfortunately, there is not yet any satisfactory means of describing quantitatively the degree of machinability any given consumer may consider indispensable. If there were, it might be possible to evaluate the relative importance of strength and machinability, and set up a specification consistent with the best interests of consumers whose major purpose is to attain economy in fabrication rather than a given strength standard.

Gives Some Causes

Under the usual metallurgical conditions, an increased resistance to cutting may arise from several causes:

1. Perfectly normal malleable of such ductility and strength as to be inherently difficult to machine.
2. So called "picture frame" iron which has a steely surface, difficult to cut, but is normal within.
3. Iron which has a wide decarburized rim, is not hard, but tough, and hence machines slowly.
4. Iron which is pearlitic throughout or in extreme cases may approach original hard iron in micro-structure.

The second and fourth difficulties can be entirely guarded against if the customer will inspect test lugs left on the casting for that purpose and reject those which have the readily recognized fractures characteristic of these difficulties. Such castings frequently can be reclaimed perfectly by an appropriate heat treatment. The fault is almost always due to pure accident, rarely representing a metallurgical defect.

The first cause is actually not a defect, but represents merely the selection of the wrong grade of material for a given purpose. Incidentally, it may be said that trouble from this source will occur only where machining rates are already crowded to the limit.

The second defect is difficult of recognition except by the metallographer and neither it nor the first are readily detected by test lugs. Hardness tests of the usual types are utterly useless. Only the fourth condition would be recognized by such test, and it is found more easily by test lug inspection.

There is in no case any definite relation between cutting and indentation hardness sufficiently marked to allow the use of the latter as a measure of the former. Losses from the destruction of tools are almost invariably due to the second and fourth causes, the other two, at most, setting a limit to cutting speeds.

A major commercial problem is dealing equitably with the condition exist-

ing when there are delivered to the consumer a great number of satisfactory castings through which a few of inferior machinability are scattered without any means of finding them. A few hard castings will disorganize a day's production schedule by the breaking of tools. To this extent, they work an injury on the user out of all proportion to their number. On the other hand, it is distinctly unfair to the producer to return to him a carload of castings which may be all good except one or two which have given trouble.

It is under such circumstances that test lug inspection by the consumer will work wonders by enabling him to check the castings before delivery to the machines and by relieving the producer from the sole responsibility of seeing that not a single poor casting goes on with those which are acceptable.

The subject of welding castings is associated closely with that of machining. It probably is admitted that defects involving a reduction of strength in critical parts never should be repaired by welding. An extension of this principle to all defects is not economically sound.

Many surface imperfections can be repaired perfectly by a welding operation with a consequent saving due to decreased foundry losses, and without risk of inferior service to the consumer. Such welds can be made identical in every respect with the surrounding metal, if necessary.

Welds made with white cast iron filler rod and subsequently annealed are undetectable unless accompanied by a visible defect of workmanship, and would be admissible for any purpose if assurance could be had of their subsurface soundness. It is a great injustice to reject all welds because improperly made welds are difficult to machine.

Consumers' Requirements Illogical

Lastly, the author would allude to practices on the part of consuming interests which seem to him highly illogical. Why do some consumers want to buy a high grade metal without being in any degree interested in the mechanical soundness of the casting as a whole? Why do other consumers insist on mechanical soundness in places and under conditions where a failure of the part is unthinkable? Why are cast parts so frequently designed by persons entirely unfamiliar with foundry problems and without that consultation with foundrymen which would eliminate many difficulties? Why should so many producers insist on early deliveries to an extent which makes it virtually impossible for the foundrymen to give adequate time and attention to their requirements?

Self interest would seem to dictate to buyers a policy of eliminating serious and important defects in the interests of satisfactory use, while ignoring, in the interest of ecomomy, technical flaws which are without effect in the intended use of the product. Similarly, the user should certainly be as much interested as the producer in making it as easy as possible to secure the best results under given conditions.

The tendency of a manufacturer to reduce his stock of material in process is most laudable as a means of economy. Naturally, he strives for early delivery from his source of supply. On a perfectly standardized article, the producer of the semifinished product can meet this demand by carrying a stock for the consumer. No overall economy results, for the same amount of capital is still invested in inventories, the producer merely acting as a banker, with or without adequate return, for the consumer. Even this course is generally not open to the jobbing foundryman who may have no assurance that any castings made up ahead will ever be required.

On work from patterns previously used by a given foundry, the greatest time consumption in the manufacture of malleable castings is in the annealing operation. The subject of the possible commercial reduction in annealing time probably has been discussed sufficiently. The present status of this matter seems to the author as follows:

Nothing has appeared in recent years which suggests to the progressive malleable foundryman any useful changes in regard to his heat treatments.

Engineering improvements in furnace design, the tunnel kiln for example, which make for greater uniformity of temperature and better control and reduce the overall time by reducing the time spent in heating and cooling. So long as castings must, for economic reasons, be handled in bulk, their own heat capacity sets commercial limits upon these rates. The actual temperature cycles of many foundrymen are already as efficient as they can be made within the present limits of furnace design and stock heat capacity. The problem of reduction of annealing time is that of finding chemical or other conditions under which the process of graphitization can be accelerated without undue detriment to quality or cost of product. The possibilities of temperature in this direction have been practically exhausted.

The question of chemical composition with respect to the usual elements, while admitting of further quantitative study, is qualitatively well understood by many, and revolutionary changes are not to be anticipated. Whether careful study of other elements of composition, or other vaguely suspected variables, will result in commercial improvements must await the event. It must be remembered that, to be industrially valuable, a process must be both metallurgically and economically workable.

In cases where new patterns are to be made, experimentation as to the most economic methods of manufacture or the best means of securing adequate soundness of casting must be taken into consideration. Castings made without such study, from new equipment, are likely to be inferior.

Finally, it should be remembered that over an extended period of time, the buyer will pay for all he gets and the seller will give value received. There are perfectly good reasons why Detroit's leading citizen does not sell Lincoln and Ford cars in competition with each other.

Crane Builders Organize

Officers of the Electric Overhead Crane institute, formation of which was completed at Washington a few days ago, are: Henry W. Standart, Northern Engineering Co., Detroit, president; Frank A. Hatch, Shepard Electric Crane & Hoist Co., Montour Falls, N. Y., vice president, and S. Buckley, Niles Crane Corp., New York, secretary-treasurer. Members of the organization are: Alliance Machine Co., Alliance, O.; Cleveland Crane & Engineering Co., Wickliffe, O.; Morgan Engineering Co., Alliance, O.; Milwaukee Electric Crane & Mfg. Corp., Milwaukee; Box Crane & Hoist Corp., Philadelphia; Harnischferger Corp., Milwaukee; Manning, Maxwell & Moore Inc., New York; Niles Crane Corp., New York; Whiting Corp., Harvey, Ill.; Northern Engineering Co., Detroit, and Shepard Electric Crane & Hoist Co., Montour Falls, N. Y.

Receives Promotion

W. H. Brandt, formerly advertising manager, Chain Belt Co., Milwuakee, has been apointed assistant secretary to succeed G. M. Dyke, who has gone to Cleveland to assume the duties of secretary of the Stearns Conveyor Co., a subsidiary of the Chain Belt Co. A. R. Abelt now is advertising manager.

Casts Pipe Centrifugally-I

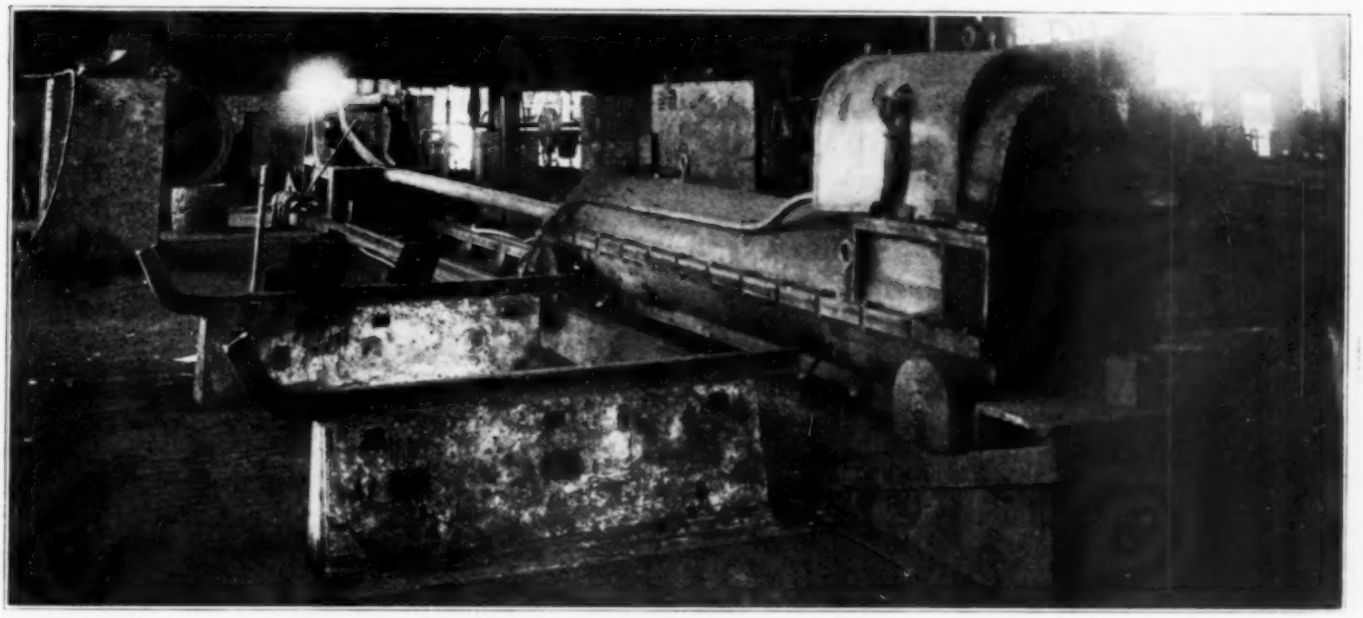


Fig. 1—Complete Machine for Manufacturing Cast Iron Pipe Centrifugally

By E. C. Kreutzberg

FOLLOWING the development of large scale production of cast-iron pipe by the deLavaud centrifugal process at its Birmingham, Ala., works as described in THE FOUNDRY, Sept. 15, 1923, the United States Cast Iron Pipe & Foundry Co. enjoyed an increasing demand for this product which necessitated the creation of additional capacity. From a geographical standpoint it was decided that the best location for this additional capacity was at its Burlington, N. J., works. This new deLavaud plant at Burlington, located on the Delaware river immediately adjacent to the old sand-cast pipe plant, recently was completed and now is in operation.

This new plant commands attention as one of the finest specialty gray-iron shops in the United States. It was designed by the company's engineering department and erected under its direct supervision. Based on the experience with the original experimental deLavaud unit at Burlington and later with the development of large production by this method at Birmingham, a plant has been evolved which is fitted in every way to get out high output of the particular product with the least amount of labor and overhead cost. The equipment has been so located as to assure uninterrupted production throughout the working hours. With respect to the saving of labor, the company has not made any definite announcement. It may be stated, however, that a comparison of the number of men to be seen around the sand-casting plant and those at work in the new deLavaud division affords a definite impression, particularly in view of the amount of tonnage produced by the old and new methods.

At present the new plant at Burlington comprises eight centrifugal machines, of which five are operated regularly. These five machines have a total output of approximately 1200 lengths of 4 to 12-inch pipe a day. Three of the units are devoted to the production of 4 to 6-inch pipe. The other five produce 8, 10 and 12-inch diameters. In designing and constructing the new plant, provision was made for the installation of additional facilities as needed in order to meet the increasing demand for centrifugally cast pipe. As a matter of fact, the units now in operation comprise half of the expected ultimate capacity. The space held in reserve is sufficient to accomodate eight additional deLavaud machines and all accessory equipment.

FIG. 2—ALL PIPE IS TESTED TO DETERMINE THE HARDNESS

The buildings comprising the new deLavaud department at Burlington are of brick and steel, with large window areas for lighting and ventilation and with roofs of book-tile protected by felt and asphalt composition covering. Some of them have concrete floors in whole or in part, but most of the floor space is paved with vitrified brick. In addition to being of the most substantial construction, the buildings have been laid out to insure continuous and balanced movement of production through all stages from the material yard to the shipping department. The heart of the plant is the foundry, 375 x 120 feet. Adjoining it on the south side, but without any intervening wall, is

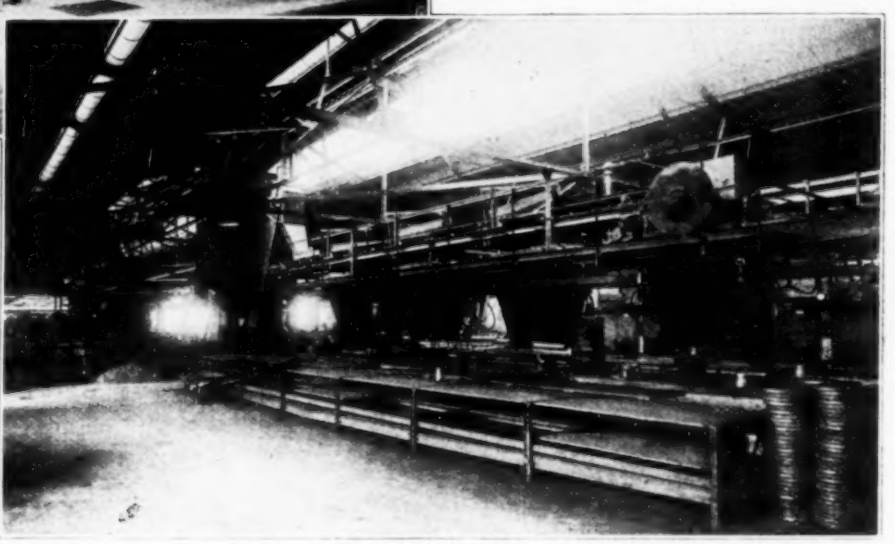
FIG. 3—(ABOVE)—BATTERY OF SIX ELECTRICALLY CONTROLLED OVENS FOR BAKING THE CORES

the annealing building 370 x 60 feet. Four sheds for cleaning, coating and testing the finished pipe, each 200 x 40 feet, are immediately south of the annealing building. Immediately north of the foundry and integral with it are two cupola houses, one 106 x 66 feet and the other 53 x 66 feet. North of the cupola houses and extending to the bulkhead line of the Delaware river is the material yard. In addition to these main portions of the plant, there are numerous accessory features which will be mentioned later.

One of the most impressive features of the new plant is that the crane runways all are suspended from the roof trusses. As a result the foundry presents the unusual spectacle of a total floor area of 375 x 180 feet, unbroken by a single column.

Materials are brought to the plant in Delaware river barges or in railroad cars. Spanning the material yard are three overhead traveling cranes. These have a span of 50 feet and a travel of 200 feet, which enables them to command the cupola charging floors at one end and the river wharf at the other end. Most of the pig iron is received in barges, from which it is unloaded by magnets. A large tonnage of pig iron and scrap also is unloaded by magnets from railroad cars. The material yard is traversed by seven tracks. Five of them are standard gage, for receiving pig iron, coke and limestone. One of these tracks is on an elevated trestle where coke and limestone may be unloaded from cars with hopper bottoms. Two of the material yard tracks are narrow gage and are employed for loading pig iron and scrap into charging skips. These tracks are equipped with scales for weighing the contents of charging skips.

FIG. 4—(BELOW)—THE CORE DEPARTMENT IS LOCATED IN THE EAST END OF THE ANNEALING BUILDING



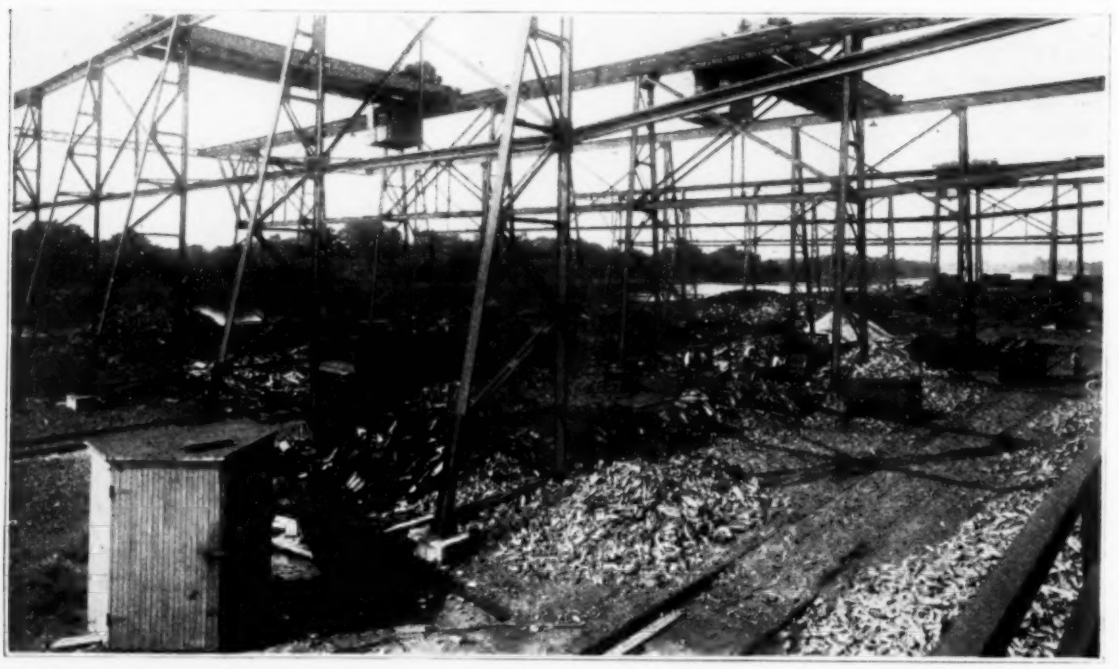


Fig. 5—Stockyard of the United States Cast Iron Pipe & Foundry Co., Burlington, N. J., Showing Facilities for Handling Raw Materials

The cupolas are equipped with charging chutes into which the contents of the skips are discharged by the traveling cranes. Coke and limestone, however, are forked by hand into side charging doors; for weighing these materials the charging platform is provided with scales. Positive pressure blowers, direct motor driven, are located in a totally enclosed blower room directly under the charging floors where they are easily accessible.

Four cupolas comprise the present melting equipment. They operate on alternate days, making two active every day. They pour continuously into reservoir ladles having 12,000 pounds capacity each. These are mounted on wide-gage tracks so that each ladle may be moved from one cupola to another. The reservoir ladles are tilted electrically and the iron, as needed, is fed into pouring ladles which are transported by cranes to the casting floors. Each of the four cupolas has capacity for melting 20 tons of iron an hour. The shell diameter is 96 inches and the diameter inside the lining 70 inches. A monorail system with cast-iron buckets has been installed at the rear of the cupolas for receiving the slag. These monrails are in the form of two loops, each loop serving two cupolas. The slag buckets, when filled, are moved to the other side of the loop and their contents dumped into hopper cars. The latter then are rolled out to the dump and emptied. In front and to the side of the cupolas is a steel rack equipped with pig molds. Into these molds any iron remaining after the days operation is poured from the bull ladles so that this surplus iron again may be available in convenient form.

The overhead foundry cranes, previously mentioned as being suspended from the roof trusses, are five in number. Two 5-ton cranes, with 50-foot span, transport the molten iron from the reservoir ladles of the cupolas to the tilting ladles at the spigot end of each of the deLavaud units. Directly over the machines is a 5-ton crane with 15-foot span which is employed for charging the molds in the machines. Two 5-ton cranes with 45-foot span receive the hot pipe from the deLavaud machines and transport them to the battery of electrically controlled annealing ovens.

Testing Coal and Coke

The bureau of mines in co-operation with committee D-5 on coal and coke of the American Society for Testing Materials has made a careful study of the accuracy of the various analytical methods for determining the sulphur content of coal and coke and found that the bomb-washing method and the sodium peroxide method when properly performed proved as accurate as the Eschka method. It is proposed to standardize the methods of analyzing and testing and make the most accurate and workable methods available.

Graphite in Facings

Foundry facings consume more graphite than any other product according to a bulletin from the bureau of mines. In 1924, 52 per cent of the consumption for finished products was used for foundry facings. Pigments and paints were second with 18 per cent and crucibles third with a consumption of 13 per cent.

Holds Sales Conference

S. Obermayer Co., Chicago, held its annual sales conference in Chicago on Dec. 21 and 22. Representatives from the various offices of the firm were present as executive and department heads from the main office. Detailed discussions of the company's products occupied the two-day session.

Cast-Iron Pipe Made in N. J. in Early Eighties

BEFORE the settlement of Burlington, N. J., in 1667, the present site of the United States Cast Iron Pipe & Foundry Co. was owned and occupied by a Peter Jegou. Here he kept a home for the accommodation of those traveling from New Amsterdam to the lower province. It was at this house that George Fox stopped on the night of Sept. 10, 1672 while on his religious tour. He described the place as one from which the Indians had driven the inmates and from which on the following day his party was paddled across the river to an island called upper Dimidock and from there to the mainland.

In 1866 Andrew McNeal purchased about 131 acres of this land for the purpose of building a pipe foundry. Although the first pipe to be cast in this country probably was used in the Philadelphia water system in 1801, this foundry of McNeals may be regarded as one of the forerunners of the pipe industry in the United States.

To lead up to the construction of the foundries at Burlington, N. J., it is necessary to trace lightly the history of cast-iron pipe in this country. A molder and coremaker, Mark Adams, had a small foundry at Weymouth, N. J., where he made pipe for the Philadelphia water system as early as 1810. From 1830 a large quantity of the pipe cast in this country was made at Millville, N. J., in the foundries of David Wood. It was here that Andrew McNeal and R. D. Wood, brother of David Wood, became associated. It was in Millville that John McNeal and Walter Wood grew up as boys together. Later John McNeal and R. D. Wood built a foundry at Florence, N. J., for their sons, Andrew McNeal and Walter Wood. About 1866 there was some disagreement and McNeal withdrew with about $30,000.

He then came to Burlington, bought the previously mentioned land, and constructed a substantial foundry. The stone for shop No. 1, which was built about 1872, was brought from Lambertville, N. J. In 1876 shop No. 2 was built and in 1886 the erection of shop No. 3 was completed. Although in 1888 this company was known as the McNeal Pipe and Iron Works it was given the name of the McNeal Pipe & Foundry Co. in 1890. At this time pipe from 1½ to 48-inch diameter was cast and the combined daily melting capacity of the foundries was about 200 tons.

The name of this company changed many times from the date of its establishment until it became the United States Cast Iron Pipe & Foundry Co. John McNeal and Sons were followed in 1876 by the firm of McNeal and Archer. It was from this firm that the city of Boston bought pipe in 1879. They in turn were succeeded by A. H. McNeal and Brother who were shortly followed by A. H. McNeal. At this time about 250 men were employed at the works. From 1890-1896 the company increased the size of their output to 60 inches and also made flanged and flexible joint pipe.

Reviews American

Steel Foundry Industry

Electric Steel Furnace Is Developed in Europe—Statistics on Capacity and Output Are Tabulated

PART III

By R. A. Bull

FORTUNATELY, in the competition between steel foundrymen and malleable iron foundrymen, unjustified claims regarding average properties of either product are being eliminated. There should be a mutually appreciative and fairly competitive spirit actuating both classes of producer. Probably this condition will depend on recognition on the part of manufacturers of the weaker material, of the properties of the stronger one; and admission on the part of the makers of the stronger material, that it is economical to employ the weaker one where the severity of known service conditions does not overtax the resistance of the product. The terms strength and weakness are employed here in a general sense, embracing toughness.

Comparisons are odious in metallurgy only when they are unfair in origin, interpretation, or acceptance. The final success of any manufacturing establishment will depend in no small degree on its honesty in promulgating information regarding its own product, and in meeting claims made for rival products. Neither of the two industries that reasonably may be considered as occasional competitors of the steel foundry industry may be attacked advantageously by efforts to sell steel castings where forgings or malleable castings should be employed. The forger and the malleable founder will not gain lasting benefits from efforts to introduce their products where, from an economic standpoint, steel castings should be applied.

Looking forward and judging from developments of the last decade as well as from reasonable prospects, it would appear that the steel foundryman has every reason to be optimistic regarding the competition of the future, in so far as it may relatively affect his merchandising efforts to maintain and to further advance the extensive use of steel castings.

Considerable could be written about past, present, and future developments relating to specifications for steel castings. Mention has been made of the requirements customarily prescribed in the beginning of the present century when ductility values far below those demanded today were acceptable to ordinary consumers of steel castings. A wholesome effect on the industry was produced by the zealous systematic study of the behavior of steel castings under shocks and stresses of exacting kinds, undertaken about 1900.

Such analysis of performance was stimulated greatly by war needs embracing in many cases conservation of weight and maximum toughness or resistance to wear under heavy demands. Discovery of the highly important relationship of heat-treatment to the above mentioned and other characteristics of performance had much to do with the stimulation of steel foundrymen in improving methods for annealing, normalizing, and heat-treating according to special procedures, the products of their plants.

Possibilities for future researches in the steel foundry industry are discussed at length in this article, which is the third section of a paper presented at the Detroit convention of the American Foundrymen's association, Sept. 27-Oct. 1.

Almost simultaneously with the development of information on the influence of heat on the physical properties of steel came the beginnings of systematic investigations of alloy steels for castings, for a fairly wide variety of uses. Probably the handicap to the steel casting industry of over-expansion during a few years, was more than offset by the stimulated development of scientific heat-treatments and the origination of those combinations of the elements which place the product in the category termed alloy steels.

Unfortunately, some years ago there developed the tendency of certain consumers to include chemical limits other than those for phosphorus and sulphur, while prescribing minimum physical properties. It is regrettable that this movement gained followers to an extent that has handicapped steel foundrymen who have been placed under unreasonable restrictions occasionally by lack of technical knowledge displayed by some consuming interests. Certain individuals advocate rejection limits for carbon, manganese, or silicon, one or more, in a product required to have minimum values for physical properties, but which would not be influenced harmfully by wide deviations for chemical limits proposed.

Engineers preparing specifications should not lose sight of the fact, of enormous significance in metallurgy, that the percentage of any element cannot be considered scientifically except with relation to the prevailing percentages of many, if not all of the other elements in the steel. This renders ineffective the helpful purposes undoubtedly actuating those who, for example, would, if they could, limit the steel casting producer to a maximum manganese content of 0.85 per cent. The proper proportion of manganese or silicon, or each of certain other elements, is what is needed according to the existing combination of the elements in the metal, considered with respect to the anticipated service of the product.

Imposing comprehensive chemical limitations causes the purchaser to assume a portion of the responsibility that should be placed alone on the manufacturer. An additional handicap is the discouraging effect on steel makers. Some of the manufacturers probably would have shown more zeal than they have exhibited in the intentional production of steel of unusual chemical composition for experimental purposes, if there had not been manifested by certain consumers a conviction that they should reject metal containing percentages of the elements differing from those narrowly prescribed.

An instance of misguided effort made by some responsible consumers to prescribe how steel shall be made, may be mentioned. The writer was confronted a few years ago by a specification dated March 28, 1917, prepared by the engineers of a company making boiler plant equipment. The specification was for important steel valve castings. The blueprint

showing the castings called for acid open-hearth steel, annealed, to have a silicon content of from 2.00 to 2.50 per cent; a sulphur content of 0.08 per cent; a phosphorus content of 0.40 per cent; a manganese content of 0.60 per cent; and a carbon content of 3.25 per cent. Physical tests were required for the material specified. It is unnecessary to elaborate on the negotiations that resulted in the delivery of a suitable product.

Avoid Ambiguous Language

Fortunately, for the benefit of the producers and consumers of high grade steel castings, it is gradually becoming apparent to those clothed with the responsibility of preparing specifications for steel castings, that ambiguous language should be excluded. Recommendations as to foundry practice have no proper place in instruments like specifications, the clauses of which should be of mandatory character. Indefinite conditions regarding heat-treatment should be succeeded by positively worded provisions instead of such phrases as: *The castings shall be properly annealed.* There are a great many details of foundry practice not mentioned even by suggestion in many commercial specifications which are of the greatest importance in the production of sound steel castings, some of which deserve consideration as reasonable to cover in a positive manner, affording desirable protection to the buyer and appropriate latitude to the seller. It is, in brief, equitable and scientific to use specifications for steel castings which place no undivided responsibility for careful manufacture on the foundryman through the imposing of unwarranted chemical limitations, but which will prescribe so far as is practicable, those details conceded to be safeguards in making a product, the characteristics of which cannot be gaged completely by the customary physical tests, by chemical analysis, by microscopic examination, or by all of these means combined. The writer believes that during the next decade a significant movement in the direction indicated will develop, which will result to the distinct advantage of high grade producers and those whom they supply.

A few comments seem advisable regarding limitations for sulphur and phosphorus. The joint committee on the investigation of the effects of phosphorus and sulphur in steel has been conducting a comprehensive research into the effect of sulphur for approximately seven years, and has published, through the agency of the American Society for Testing Materials, several preliminary reports. The last of these, presented at the June, 1926 convention of the testing society, was the first expression of a conclusion reached by the joint committee. In the past, engineers have not agreed as to the desirable upper limit. The more liberally minded have established the dead line at 0.06 per cent, while the ultra-conservative contingent has looked askance at a sulphur content exceeding 0.04 per cent. It is not surprising that previously, in the absence of authoritative information as the result of a sufficient number of comparable tests, judicious engineers have followed the policy of playing safe. The published results of thousands of tests covering the extraordinary comprehensive investigation by a large representative committee who conducted their research by disregarding all theories previously held, afford a scientific basis for universal agreement that a sulphur content of 0.06 per cent does not reduce the serviceability of steel castings.

The technical world will now look forward with great interest to the periodic publication of data by the joint committee on the effects of phosphorus. Study of this element is to be undertaken soon. It would be premature now to offer any comments regarding desirable modifications of the required phosphorus content in specifications for steel castings.

It would be presumptuous of anyone to make definite prophesies covering numerous specific fields of research which will be attacked most successfully by the industry in the future. Many operations that have been under investigation, have yielded much of value and will continue to place at the steel founder's disposal, data on which to base improved practices. Some subjects occasionally have been studied in a haphazard manner by individuals who were at a disadvantage because they had routine operating responsibilities. It may not be out of place here to refer to a few investigations of present and future significance.

Future Technical Investigations

A subject to which considerable study has been given during the last five years is that of molding sand. The work of the joint committee on molding sand research should be known well to all foundrymen. It should be unnecessary to advocate hearty support of the work of the joint committee, which centers the attack on the problem by means of organized co-operation, the results of which are available to the technical world. Many steel foundrymen have obtained and more will secure in the future, distinct advantages from the activities of this joint committee.

In the search for an ideal facing sand, possibly all steel foundrymen at some time have committed the error of observing the apparent results of the facing without proper regard for the contaminating influences on the castings, of unclean and improper gating, and unskilful pouring. Many steel foundrymen have reached the conclusion that there are numerous grades of sands that are probably well suited to their product, if they are skilfully bonded and handled.

Sand Prepared Carefully

Probably the average steel foundry of the future will devote much more attention than it does now to the careful proportioning of the ingredients, to their thorough blending, to the regulated percentage of moisture, and to the suitable handling and storage of the prepared sand in ways that will prevent deterioration and subsequent unskilful treatment by the molder. Means probably will be provided in many steel foundries for daily gaging refractory properties to prevent deterioration of the heap sand. Sand control methods have made their entry into progressive steel foundries in a manner that assures the permanency and future expansion of the policy.

Degasification of steel, which is a more correct term than deoxidation, frequently employed as indicative of the identical condition, presents a problem of baffling nature even to those steel foundrymen who have personnel and equipment for conducting intensive studies embracing practical and theoretical details. Reference has been made to the importance to the industry of the development of green sand molding. A feature of this kind of molding, relating in an important way to the reasonably thorough degasification of steel, is the influence on it of the high percentage of moisture in green sand as compared with the proportion in an oven-dried mold.

There are highly qualified metallurgists associated with companies skilfully producing certain alloys, the chief function of which is to cleanse the steel by the liberation of gases. Unfortunately some of these gentlemen, through lack of familiarity with commercial steel foundry conditions, make deductions and give assurances regarding the useful substitution for aluminum, of alloys that prove to be disappointing in the two-fold effort to maintain in the metal the original degree of ductility, and to put the

steel in such a condition when poured in a green sand mold containing ordinarily from 4 per cent to 5 per cent moisture, that there will not exist in the interior or on the surface of the resulting castings, the slightest evidence of porosity, commonly termed *pin-holes*.

Pouring steel into molds containing a fair percentage of moisture, and pouring into cast iron ingot molds are two different things, particularly when we keep in mind the mechanical processes to which the ingot is later subjected, changing in a radical manner the characteristics of the pockets originally containing gas.

Without doubt there is opportunity for the prolongation of carefully planned investigations to develop a material that will serve the double purpose to which we have referred. It may be that the complete elimination of aluminum in the steel foundry is an objective that never will be reached. A few writers on steel foundry topics occasionally have referred to shop practices in a way indicating that they do not employ this element because of its bad influence on physical properties. Technical exploiters of deoxidizers have expressed themselves along similar lines. Painstaking efforts to obtain evidence from the manufacturers of deoxidizers and degasifiers disclose nothing completely satisfactory, when the standard employed for determining the results is a green sand mold of a design that, despite liberal provision for mechanical venting, has, by experience, been found somewhat peculiarly susceptible occasionally to a few pinholes. Practical steel foundrymen know that such susceptible casting designs exist, and that successful manufacture in such cases is attended by intelligently regulated aluminum additions.

Frankness Pays

In the final analysis, the interests of steel foundrymen, of their helpful associates who produce degasifying alloys, and of consumers who need steel castings of the highest grade, will not be served by attempts to cloud the issue that presents for the future, a problem justifying much research. Among other things, the progressive steel foundryman has learned that it pays to be frank, and that exaggerated claims and deceptive gestures are not profitable eventually.

Much has been done within the last 10 years to ascertain the potential physical properties in steel castings by the application of varied forms of heat-treatment. Considerable impetus has been given the steel casting in this respect through the concentration of attention on the subject by users of an enormous variety of steel products other than those made in the foundry.

Rapid growth of the American Society for Steel Treating is sufficient evidence of the present aggressive disposition to develop heat treatments best suited to the peculiarities of the product. Researches in the steel foundry for many years will be conducted into the subject of heat-treatment, and will, of course, include consideration of the different types of ovens, including those lately developed which employ electric current.

Among the operations that have provided channels for investigation are those related to gating and heading. There is no necessity for elaborating on this topic, but it appropriately may be mentioned as one deserving the continuous attention of investigators, many of whom will learn more than they now know regarding the principles that ought to be observed in permitting entry of the metal, and ample but not excessive opportunity to supply the void created during solidification. This problem is one of particularly local significance. It is made complex in the jobbing shop, where broad experience and marked ingenuity may be regarded as indispensable for economical practice, frequently aided by experimental work.

Composition control of steel is a factor in the satisfactory nature of the foundry's product which is deserving of research in many plants. Close approach to the locally desired proportion of each of the five commonly determined elements in steel, even when followed by properly applied heat-treatment, by no means provides invariably the means for obtaining superior physical properties. The steel may be inferior, yet come within close chemical limits prescribed. The result of the annealing or normalizing treatment may be all that could be expected, yet the performance of the physical test specimens may show undesirable material. However, the satisfactory uniformity and agreement with established values of physical tests cannot be expected unless there is a fair degree of uniformity in chemical composition. For this reason and because of the fact that never can steel melting be positively and completely controlled, there is opportunity for useful research in the future, to closely approach the ideal of undeviating chemical composition.

Opportunities for future research in the steel foundry are almost innumerable. Many investigations can be prosecuted into operations that are quite dissimilar and have important cumulative effects on the product. Certain investigations naturally divide themselves somewhat along what are considered the more scientific lines that are primarily theoretical, and those regarded as of more practical significance. When analyzed closely, these distinctions disappear.

Practical Viewpoint Necessary

Research must be practical to justify itself in industry. The true measure of practicability is the probability of applying the information obtained, with ultimate economic advantage. Disregarding the element of time, we might consider that many opportunities for investigations may result usefully, and that our distinctive use of terms is superfluous. This brings us back to the same starting point for classification. The logical method for making progress that will be recognized and encouraged by those who make steel foundry research possible, is the practical attack aided by theoretical study, of problems according to the preferential order of their present seriousness.

Perhaps we have suggested the elimination of narrowly defined practical and theoretical classifications for steel foundry investigations. It is not out of place to indicate the maintenance of a practical viewpoint as an indispensable feature of steel foundry research. Any one clothed with the responsibilities of conducting technical investigations in the steel foundry industry should know steel castings; and should understand the conditions that daily attend foundry operations, where there is nothing that bears a resemblance to the quiet atmosphere characterizing the laboratory.

In this final section the writer has dwelt at considerable length on a few of the possibilities for future researches in the steel foundry. He does not wish thus to pose as being original. Occasionally, topics acquire their true significance only by fairly frequent reference serving to emphasize them. There should be no doubt that technically and commercially the future of the steel foundry industry in the United States will be related directly and closely to the investigations that will be made into the details of manufacture, distribution, and performance of the product. When the middle of the present century is reached, marking achievements in the manufacture of steel castings in the United States for 85 years, the conditions of the industry will present a reflection of the investigational work done by it within the next 20 years.

Deoxidation Misleading Term

An Important Feature in Melting Nonferrous Metal Is the Ability To Determine Whether the Molten Metal Should Be Oxidized or Deoxidized

By Charles Vickers

ACCORDING to the dictionary, to deoxidate is to deprive of oxygen; or reduce from the state of an oxide, and deoxidation is the act or process of reducing from the state of an oxide. The word deoxidate, or deoxidize as it is termed more frequently is used so often by the brassfounder and by those who desire to assist him in his *troubles* that a discussion of the deoxidation of nonferrous metals may prove of considerable interest. As the word is understood by most brassfounders and their assistants in the metal industry, it means adding some substance, usually in metallic form, to a melt of copper or its alloys for the purpose of reducing or removing the oxides that are supposed to exist within the molten mass.

Presence of these oxides is held responsible for gas holes of various size and shape, also for the lack of density that renders the castings unable to withstand air or water under pressure.

Whenever castings are found porous and otherwise unsound it is assumed that a *deoxidizer* is needed to remedy the condition. If one had been used, without effect, then either it was of no value, or the wrong one for that particular alloy.

As the deoxidizer is added to correct an abnormal condition it may be regarded as a medicine. In fact persons who consider themselves unusually skilled in prescribing for such conditions frequently call themselves *Metal Doctors*. While the appellation in this connection is not particularly happy, it is not entirely inappropriate provided the person adopting the title is not too biased in his own favor.

In the diagnosis of diseases whether of metals or of men, the element of chance cannot be ignored. Symptoms produced by unrelated causes may appear almost exactly similar. It becomes necessary to know as much as possible of the operations involved in producing such results, and in many cases this knowledge only can be acquired by personal contact with the work at all stages.

When this specific knowledge is not available the element of chance enters and reduces the diagnosis to simple guesswork. As a result of such experiences even veteran brassfounders have found themselves mistaken so frequently, they generally are ready to lend a willing ear to the suggestions of the wanderers who visit them in the interests of sales organizations.

Wheat Among the Chaff

They always are hopeful of finding a few grains of golden wheat among the chaff so freely offered. From the fact that they always are ready to listen and buy it is evident the pertect *deoxidizer* has not yet materialized. No medicine is known, either metallic or nonmetallic, that can be regarded as a cure-all for every disease of porosity and unhomogeneity that afflict castings of copper base alloys, either red, yellow or white.

Probably a perfect, or universal deoxidizer never will be found. One which added in small amounts automatically will drive out all the gases that produce holes in the castings. The gassed effect may be due to causes originating in conditions diametrically opposed.

A fruitful source of gassing of metal in the furnace is overworking the reducing flame we read so much about. When the metal is overdeoxidized in melting the addition of still more of the same sort of medicine will be the reverse of beneficial. What is required is an oxidizer instead of a deoxidizer.

When the alloy contains lead and a little more will cause no harm, the addition of a few ounces of litharge has effected a cure. Also thin copper wire from which insulation has been burned is useful material because it carries the oxides of copper, and thus acts as an oxidizer.

In coke-fired crucible furnaces this material may cause trouble from porosity as it introduces oxide of copper which oxidizes any sulphur present and forms the gas sulphur dioxide which makes holes in the castings. It will cause trouble when melted in quick melting oil-fired furnaces. Some types of electric furnaces work with a reducing atmosphere and if trouble should develop the oxidized wire is much more likely to correct the difficulty than would the addition of any deoxidizer.

In refining a bath of copper the smelter first proceeds to oxidize it; usually by blowing air in under pressure. This operation first removes the impurities by oxidation. Oxides come to the surface as slag. They have a greater affinity than copper for oxygen and take it first. The operation is carried to the point where a small quantity of the copper also is oxidized to make certain all the impurities that can be so removed have gone into the slag, or have escaped in the gaseous state.

The next operation is to deoxidize the copper and this must be carried out in a manner that will not deoxidize the impurities. Otherwise all the work will result in nothing. The bath will return to the former impure condition.

It is common knowledge that this deoxidizing is done by pushing green wood into the metal. The burning wood releases steam and gases, such as hydrogen, which take the oxygen from the copper and evaporate it leaving the metal behind. This operation of poling has to be done skilfully to bring the copper to the condition desired, which does not mean the elimination of all the oxide it may contain. When that happens the gases from the wood are retained and produce a condition undesirable for many of the purposes for which copper is used.

Sometimes shipments of ingot copper are found to be slightly overpoled. This condition is indicated by minute gas holes when the fractured surface of an ingot is examined. The foundryman usually feels justified in registering a complaint and thinks he has sustained an injury. The effect is purely psychological since the metal is perfectly satisfactory, but it makes a fine peg on which to hang all troubles that may develop and air them in the office.

A little reflection will show that copper in such condition is better, if anything, for remelting purposes than a tough-pitch copper, except of course in furnaces working with reducing atmospheres. When the oxygen-free copper is remelted in fuel furnaces the overpoled condition is corrected

by the oxidation that cannot be prevented. Consequently such copper when molten will contain a minimum of oxides. The addition of the alloying metals only can introduce a smaller amount of their own harmful oxides, than is the case with copper starting out at tough pitch.

In making aluminum bronze it is important to add the aluminum to as nearly oxygen-free molten copper as possible because any oxide present instantly is reduced by the first addition of the alloying aluminum. Instead of cuprous oxide there is aluminum oxide, merely an exchange of oxides, not an elimination.

Oxide Becomes Abrasive

Aluminum oxide before it is fused, exists as a voluminous white powdery substance which rises lazily toward the surface of the bath of metal and usually never entirely gets there before the alloy solidifies in the mold or ingot. When a casting is machined and polished it will be found peppered with little whitish smeary specks and larger agglomerations which show most when the object is inspected obliquely against the light. This exasperating infliction cannot be remedied without understanding what causes it. Sometimes when other than cuprous oxide is present in the copper, for instance nickel oxide, the heat generated when the aluminum reduces this oxide, increases to the point of fusion of the alumina. The soft, unctuous powder is converted into an abrasive capable of ruining a machine tool or of stripping a hack saw blade at the first cut.

This condition particularly has to be guarded against when making nickel aluminum bronze. The nickel should not be melted with the copper because the nickel will deoxidize the copper. The cuprous oxide will be exchanged for nickel oxide *NiO* as the heat of formation of this oxide is over 14,000 calories greater than that of cuprous oxide. As the aluminum is added it will strip the nickel oxide of its oxygen. When the nickel is added in the shape of an alloy with copper the same thing will occur. The best way to add nickel to such bronze is as an alloy of nickel and aluminum, previously made. While the nickel probably would carry some oxide, changed to alumina, this action would be confined to the nickel oxide present in the nickel. Also if the alloy was made by dissolving thin strips of nickel in molten aluminum the reaction would be quenched by the latter and the fused oxide never would be made.

Importance of correctly handling such alloys is illustrated by the following incident: Tens of thousands of worm wheels of ordinary aluminum bronze were cast and used, without the appearance of a hard spot. In filling an order for two dozen similar wheels of *nickel* aluminum bronze, every one was rejected after one machine cut had been attempted. It was impossible to machine them on account of fused alumina.

Overpoled copper is not desirable for melting in a furnace running under reducing conditions. The additional gas will be retained by the metal after it is alloyed and thus cause porous castings. The condition cannot be remedied by the addition of any deoxidizing agent, but a small quantity of oxidized scrap copper wire or the oxide of some easily reducible metal, such as lead, will correct the condition.

The important feature is to be able to determine the proper method to follow, whether to oxidize or to deoxidize. Too much attention has been given to the deoxidizing method and not enough to the need for oxidation. Because of the general assumption that poor metal has been oxidized irrespective of the conditions under which it may have been melted, deoxidizers fail to produce the results hoped for in numerous cases.

Poling Requires Experts

Referring once more to the refining of copper, wood is the deoxidizer used against cuprous oxide and has been found efficient in removing the oxygen from the copper. If this work is overdone, the metal steadily grows worse with every attempt to further deoxidize and this has to be guarded against. For this reason the use of wood is not to be encouraged as a deoxidizer in foundry melting operations unless in the hands of skilled operators and in furnaces adapted to such methods. Under favorable conditions these methods have been used in foundries successfully. Cuprous oxide was reduced to a point where sound copper castings were produced from sand molds with a much smaller amount of metallic deoxidizer incorporated than would have been effective without the poling.

Impurities in copper decrease its electrical conductivity. Deoxidizers used to promote soundness usually remain in part as impurities. Therefore the less present the better, where the property of conductivity is important. Conductivity is considered important by makers of electric machines for an economic reason. If a copper conductor of 100 per cent conductivity is to be replaced by one having only 50 per cent conductivity then the latter will require double the section of the one replaced. Thus twice the amount of copper is required to do the same work. The saving of metal is apparent.

Copper castings always have been a bugaboo to the brassfounder. More so in the years past than now, for this industry, like all others, has progressed. Efficient deoxidizing agents now are commercially available and permit relatively high conductivities compared to former practice. Thus a conductivity of 90 per cent, that of pure copper, is not rare to find in castings and may be regarded as an important advance in the art of casting copper, also one that effects considerable saving of metal.

A conductivity of 90 per cent does not mean a copper content of 90 per cent. Conductivity and copper content often are confused in the minds of metal workers. When consumers of high grade copper castings ask a foundryman, for example, if he can make castings of 80 per cent conductivity the reply will be, "why certainly, and much better than that."

In making the castings he will melt 95 per cent copper, often scrap or casting copper, and then add 3 per cent zinc and 2 per cent phosphor tin. While this makes a nice casting alloy, its electrical conductivity will be less than 30 per cent that of pure copper. From the viewpoint of the electrical industry it is valueless. It is suitable for copper hammers and soldering coppers and it makes pretty castings.

Sometimes only 1 per cent phosphor tin is added with the copper raised to 96 per cent. For purposes where an easy machining mixture is desirable lead may be included, copper 100 pounds, zinc 5 pounds, lead 3 pounds. Another copper colored mixture machining quite well is copper 95 per cent, antimony 4 per cent and silicon copper 1 per cent. The silicon copper does the deoxidizing and should contain 10 per cent silicon.

Add Iron To Copper

Copper also can be hardened and deoxidized by adding iron and in such condition finds numerous uses not connected with electrical work. For best results the iron should be added as combined in yellow prussiate of potash or soda. Thus 100 pounds of copper may be melted under charcoal, if a wind furnace is used. Yellow prussiate of potash 1½ pounds and enclosed in several thicknesses of newspaper with 4 ounces of common borax is dropped gently on the charcoal covered surface of the

molten copper. In a few seconds these chemicals will begin to liquify and boil as the water of crystallization is driven off by the heat. When this action ceases they should be stirred into the metal and care should be exercised to see this stirring is not done before the water has evaporated, otherwise the effect will be the same as that produced by plunging a damp stirrer into the metal. While the conductivity of such copper is low, its copper content is high and the metal finds many applications. One use is for branding coppers and others will suggest themselves.

Copper tuyeres and similar castings are made best by using a different deoxidizer to those mentioned. Electrical conductivity is unimportant in these castings, but a high copper content is expected combined with fluidity in the molten state. Phosphorus or silicon meet these conditions, but it is not advisable to use them together. Some makers prefer silicon and others phosphorus. Either makes a fluid metal but if too much silicon is used, the tuyeres may not hold pressure without peening on account of dross which produces a flaky condition especially near the gates.

A better deoxidizer for such castings than either silicon or phosphorus alone, is an alloy of certain definite proportions of copper, phosphorus and magnesium now commercially available. A small addition will insure dense and fine appearing copper castings.

Application of Silicon

Silicon was one of the first of the modern deoxidizers introduced to brassfounders. Its use as a deoxidizer of copper was fully described by the writer in an article published in THE FOUNDRY, March 1908. The article was illustrated and shows copper fuse and buss bars with methods of molding, also the various mixtures that were used.

Deoxidizing value of silicon to brassfounders is much less than would be expected judging by its great affinity for oxygen. Its use is confined mostly to copper. In alloys of copper and tin its use has been suggested and the alloy patented, but its application has been small as it is far inferior to phosphorus in its effects on such alloys. In alloys of copper and zinc it can take the place of aluminum when the zinc content is high, with the proviso that no lead is present. Usually yellow metal contains lead and this prohibits the use of silicon as a deoxidizer and fluidizer for castings made in sand molds.

In the numerous alloys of copper known as steam metal, red brass or composition, silicon is a great mischief maker with some of the characteristics of aluminum. The majority of brassfounders are familiar with the bad effects produced by silicon additions to such alloys and on no account permit its use.

The action of silicon in the presence of lead is to produce an immense amount of dry bluish white dross which it accumulates from somewhere, but as it does not show on chill castings it is not easy to determine whence it comes from or what it is. It is not a lead silicate. This substance is easily fusible while the drossy substance formed in alloys is infusible at that temperature and is not formed in the presence of lead-free alloys cast in sand molds.

Difficulties Ensue

Experimental work so far has resulted in puzzlement instead of elucidation. If a leaded alloy of copper is made containing approximately 40 per cent zinc, it cannot be cast in sand molds unless a small amount of aluminum is added. The alloy then becomes quite ticklish to cast. Aluminum improves the flow of the metal and suppresses the fumes to a considerable extent, but also it will cause shrinkage in unexpected places and run drossy on the slightest provocation. If an aluminum treated alloy casting of this type is carefully gated, if it is risered or shrink-balled to prevent shrinks and is introduced into the mold without being ruffled, the result *may* be satisfactory, but there is just one remaining little difficulty to be smoothed out. No one with actual brassfounding experience ever would get optimistic enough to expect that these castings would withstand, for instance, even the slight pressures to which plumbing fittings are subjected. Right there is where aluminum in its deoxidizing capacity falls down, and falls down hard.

Silicon will do the same trick as aluminum in yellow brass, minus some of its bad faults. It will make the metal flow and fill the molds, something which the alloy with no silicon or aluminum would not do under any circumstances. It will do this without causing shrinkage trouble and dross when the gating is properly arranged. Also it will make castings that will stand pressures as high as plumbing castings are tested. In addition it makes a much stronger alloy than the red or yellow alloys it might replace. It would be perfect but for one little thing: No lead can be used in the alloys. Where lead is present, silicon raises more trouble than aluminum.

Alloys containing around 40 per cent zinc are of a gun metal color. They are not yellow like brass, therefore if they could be cast into sound, pressure-resisting castings the saving would be attractive. With lead omitted, the finishing costs would wipe out all saving on metal costs. It cannot be and never has been used under such conditions.

Experimental work to determine the nature of the dross produced by silicon in the presence of lead brought out another puzzle. It was found possible to entirely eliminate such formation and to form moderate pressure resisting alloys of copper, high zinc and lead by addition of silicon. All that was required was to use a catalyser with the silicon. Why this stopped the formation of such undesirable dross, and so much of it as to always spoil the castings, is a puzzle.

Apparently silicon has some remarkable properties. When alloyed with aluminum it must be *modified* to obtain its best physical properties, also to get its best physical properties, when alloyed with copper to form a silicon bronze, it has to be modified but with a different element to that required with aluminum. When used as a deoxidizer and fluidizer in high leaded yellow brass, alone it is valueless, even detrimental, but even this bad effect can be overcome. Evidently there is much to learn about this element and it looks as though it is destined to become as important an addition to the nonferrous family of alloys as it already is in ferrous metallurgy.

Metals Are Developed

Marked progress in the development of metals to withstand extremely high temperatures and pressures has been made during the past year by the Chapman Valve Mfg. Co., Springfield, Mass., according to a recent report of the metallurgical laboratory of that firm. This laboratory was started in 1921 to control foundry practice, but it soon developed into a research laboratory extending its studies into many technical fields.

At present the research laboratory is under the direction of V. T. Malcolm, chief metallurgical engineer of the firm. In co-operation with a number of national engineering societies this laboratory has developed metals which withstand pressures as high as 600 pounds per square inch and temperatures exceeding 1000 degrees Fahr.

How and Why in Brass Founding

By Charles Vickers

Insert Must Be Warmed

We are trying to make an aluminum casting in which there is inserted a small copper tube which is cast. We have difficulty getting the castings to come sound. We have tinned the copper, burned it and washed it in coal oil and wire brushed it, but still the blowholes persist. We have found that heating the tubing gives us the best success. Also we expect to make our own ingots from brass borings, and have installed a metal separator. Kindly advise us what percentage, if any, of new metal to add to the borings.

The reason the bits of tubing blow is that moisture condenses on them after the mold is closed, and naturally when the liquid metal strikes this dew covering the insert there is a kick. When the insert is heated no dew is formed on it, provided the molds are poured before the tube gets cold for when this happens, then some condensation is inevitable. A sand mold in the condition known as green is a moist place after the mold is closed, as there is a continual evaporation of the water held in the sand, which constitutes its bond with the result the atmosphere of the mold is in a humid condition, and moisture is certain to condense on any hard and cool surface presented.

A piece of metal is ideal for the dew to form on and even when at the same temperature as the mold interior there will be some condensation; enough anyway to cause a "blow" in the majority of cases. This condition of interior humidity is accentuated if the sand used for the mold is warm, and it becomes quite bad when the sand is hot and such hot sand is used for backing a cold facing next the patterns.

In the present case it is a hardship to have to heat small inserts before putting them into small molds, then also they cool before a floor is ready to pour. But it is not a hardship to store the inserts in a place where they will warm to the point where they can be handled with bare fingers, which ought to be warmer than the molding sand. Then leave the molds open on the floor until pouring time, when the signal is given the metal is near ready, core the molds with the warm inserts, close and weigh the molds with celerity, and pour right away, and there will be no further trouble from blowing. This extra work of leaving molds open, and then getting them ready just at pouring time ought to be figured in when the price is made for the castings. The amount of new metal to add to remelted brass borings is a question impossible to answer, without a knowledge of the alloy desired and the analysis of the turnings.

Use Care in Pouring

We are casting a 60-40 brass into chill molds at a temperature of around 1840-1900 degrees Fahr., and have trouble with what are known as slivers which show in drawing the tubes from the billets.

The slivers are probably due to imperfections in the billets caused by the presence of oxides. This oxide may not be held in the metal previously to pouring period, and one thing that causes it is insufficiently oiled molds, or casting without oil. This brings up the question; are the molds planed or otherwise finished? If so, the surface is too smooth to hold enough oil as when applied it will drain to the bottom. A nice smooth iron casting in the unfinished condition should be used. Sometimes they are sandblasted and the surface thus produced will hold the oil. As the brass is poured the oil burns with a reducing flame. This prevents oxidation of the metal entering the mold. Also, the oil prevents the brass adhering to the mold. As the billets are overhauled before they are rolled, it is not necessary to obtain a smooth surface on the castings. As a rule such surfaces may cause trouble.

Wants Better Solder

We are making an aluminum solder which is not entirely satisfactory. It does not have the life it should and is not sufficiently fluid. The grain of the metal is good and it holds good, but the faults mentioned spoil it. The formula is zinc, 26.2 per cent; tin, 69.04 per cent; aluminum, 2.38 per cent; phosphor-tin, 2.38 per cent. We melt the aluminum, add the zinc and then the tin, being careful about overheating. The phosphorus is added as yellow phosphorus in the shape of four sticks about 2 inches long as we do not have phosphor-tin. We would like to know whether an addition of silver would help matters as we have a quantity on hand.

The following alloy is a silver-carrying aluminum solder. Tin 85.29 per cent; aluminum 11.70 per cent; silver 8.01 per cent. However, we doubt if this alloy is any better or even as good as many alloys much cheaper because they do not contain the expensive silver. Two alloys suggested by the bureau of standards are: (1) Tin, 78 per cent; zinc, 8 per cent; aluminum, 9 per cent; cadmium, 5 per cent; and (2) zinc, 75 per cent; aluminum, 5 per cent; cadmium, 20 per cent. Possibly one of these would give better results than the formula now being used. We suggest a trial of both.

Steel in Brass Turnings

After we put the turnings from our red brass valves through the magnetic separator we find that some of the small steel chips accidentally get past and into the castings, and and we would like to know how to combine these steel chips with the brass. We use 15 per cent phosphor-copper for other reasons but find that it does not seem to combine the iron with the brass. We have tried leaving out the phosphor-copper. Will manganese dioxide, when used in small quantities combined with the flux, cause the iron to change from free iron to combined iron? Also is potassium sulphate better than barium sulphate for causing impurities to rise to the surface of the metal? Is there any way in which a red brass containing tin, 6 per cent; lead, 3 per cent; zinc, 6 per cent, and copper, 85 per cent may be made stiffer without increasing the cost of the mixture and at the same time give sound castings which are free turning?

Iron fails to alloy with the copper alloy because it holds carbon, so if some method could be discovered by which the carbon could be eliminated from the iron, or steel, the latter would melt and automatically alloy with the brass when it exists in

small quantity in a state of mechanical mixture before melting. Therefore, the problem is to remove this interfering carbon and at the same time do no injury to the brass. This is a metallurgical problem which the writer believes cannot be done. The better way would be to put the borings through two sets of machines, the last of strong magnetization, and kept for nothing but removing traces of steel.

If the iron is combined chemically with the brass, and no nodules are encountered while machining the castings, another trouble will appear. Castings will come from the sand, discolored, the depth of the dark unpleasant color depending upon the amount of iron so combined. Outside of this unpleasantness the iron does no harm; in fact for pressure-resisting castings it may even do good, as it closes the grain of the metal, and materially increases the stiffness of the alloy. This last statement can be easily proved by using a flux of 1 per cent of yellow prussiate of potash on the metal, taking care to drive off the water of crystallization before attempting to stir it into the molten metal. This will introduce iron in a state of chemical combination.

When melting in a furnace, operating under an oxidizing atmosphere the iron may be oxidized partially or completely, which causes trouble ranging all the way from a condition of sponginess and porosity combined with *hard spots* (not nodules) and messy dross to *sand* specks in the castings exactly where they are not wanted, and which, of course, the molder gets blamed for. All things considered, it is worth a great effort to exclude iron entirely from alloys of copper, zinc, tin and lead, known as red metal.

Manganese dioxide will not effect the status of the iron in any way, but some of it may be reduced by carbon and temperature or by an atmosphere of carbon monoxide, with the result of discolored castings, ranging from a pleasing shade of yellowish brown to dark brown, not so pleasing. If too much manganese should be reduced or added the surface tension of the liquid brass will be increased to the point where the film will prevent the metal flowing and filling the mold. In a crucible furnace of the coke-fired type, enough manganese will be reduced from one old dry battery to effectively deoxidize a heat of 100 pounds of bronze, and they are sometimes used for such a purpose. While some melters esteem manganese dioxide greatly in admixture with a flux, we feel there are other dexidizers that can be controlled better; manganese copper for instance.

Neither potassium sulphate nor barium sulphate have the least action in causing impurities to rise to the surface of a bath of metal, but if the use of one or the other is favored the barium sulphate is the better because it is cheaper, and carries no water of hydration. Phosphorus will not cause the iron to unite with the brass because it has no action on the carbon held by the iron; however, the phosphorus is valuable to fluidize the metal, and if a small amount only is added it probably will deoxidize. We advise care in the elimination of its use. While tin is the best *stiffener* of brass and bronze, there is a possibility a little nickel might materially assist in getting what is desired, and it might be well to try in the neighborhood of 1 per cent, replacing the copper.

Cannon Mold Carried a Water Core Barrel

By Robert E. Masters

TO the best of my knowledge no casting ever made presented the same element of danger in the foundry as the famous Rodman gun, named after its distinguished inventor Thomas Jefferson Rodman one time United States Ordnance chief of staff. Too many drawings and too much explanation would be required to cover all the details of construction of a mold for one of these guns, besides the gun has been obsolete for many years and the method never has been employed for any other purpose.

Before Rodman's time the Dahlgren gun and other makes of heavy ordnance were cast solid and bored out. Boring a 12-inch hole almost the full length of a 30-ton siege gun was a slow and costly operation. Rodman proposed to cast the gun hollow. The principal advantage of this process was not the saving effected in the machining time. Under the old method the casting solidified from the outside to the center and as a result the densest metal was on the outside. In other words the metal on the outside was in a state of tension and the metal on the inside was in a state of compression. This was exactly the opposite condition to that required to resist the shock of explosion when the gun was fired. Rodman argued that if the gun was cast hollow and further if a stream of water was circulated in the interior, the metal on the inside would cool first and reverse the conditions found in former guns. Experience proved his theory correct and many guns were made according to his plans. Progress in the art of constructing built-up guns of many layers and further advance in the methods of steel ingot production rendered these guns obsolete in the early eighties.

Manifestly it was out of the question to introduce water into the red hot core barrel after the mold was filled with molten iron. The only safe alternative was to fill the core barrel with water before pouring commenced and then keep fresh water flowing through the barrel afterward for a considerable time. This was accomplished by fitting the core barrel with an intake and discharge pipe similar to that in the ordinary household hot water tank. The intake pipe extended close to the closed bottom of the barrel and discharged cold water at this point. The heated water flowed out through a suitable discharge pipe attached to the upper end of the barrel. The amount handled was approximately 60 gallons per minute for three days.

With a barrel filled with water the usual vent holes could not be employed to take the vent from the core. The barrel was fluted longitudinally instead and was wrapped closely with firm hay rope and then coated with loam in the usual manner. The vent was all taken from the top end.

Before I left the works where these guns were made I had these water core barrels and attachments conveyed to an unused part of the flask yard and piled on some heavy oak timbers. Probably they will furnish cause for speculation for a future generation.

We did not convert any of the old guns into pruning hooks and plow shares, but we cut many of them up for scrap and for various utilitarian purposes. For example we screwed an eyebolt in the flat side of one heavy butt and used this improvised drop ball at a high derrick for breaking scrap. Several other butts were provided with eyebolts and used for mold weights.

Bill Speculates on Lucky Breaks

By Pat Dwyer

BROWSING idly through a magazine the other night I came across a learned article on the subject of child training with a view of fitting the child into the niche where he could function most efficiently in later life. The claim was advanced that every child has peculiar qualifications and if he is watched carefully he will manifest a certain leaning toward some particular form of activity in preference to others.

There may be something in the theory. Certainly a sufficient number of pegs in square holes are in existence to give the theory a semblance of plausibility, but then on the other hand that does not prove conclusively that if these pegs were shifted they would fit any better in any other hole. For all ordinary purposes I believe a boy can be dropped into any kind of a hole and in time he will come to fit it just as well as if he was whittled to fit it in the first place.

The ordinary boy does not know what he wants and has no conception of how he is going to develop. In the days of my youth I had an ambition to become a machinist. The prospect of controlling an intricate machine, of fitting the parts and erecting steam engines presented an irresistible appeal to my youthful fancy. Screwing my courage to the sticking point I applied at the office of the local iron works for a job and nearly collapsed when the clerk took me into the private office of the big mogul himself who combined the offices of president, general manager and principal owner. At various times in a long and somewhat varied career I have entered private offices and met men who controlled the destinies of more thousands of men than this man controlled the destinies of individuals, but I never since experienced the feeling of awe which overwhelmed me while I stood quaking, cap in hand waiting for this omnipotent being to look at me.

He skilfully unhooked a pair of silver spectacles from his ears and laid them on the blueprint he had been examining. The pair of eyes under bushy brows which he turned on me left me stripped naked body and mind before him. If my cowardly little legs had not died right there and then, most assuredly I had darted out through the door like a cat flying through a dairy window.

"Well, my lad," said the ogre. "What do you want to see me about?"

Timidly I made known my earnest wish to be enrolled as an humble beginner in the great and glorious brotherhood of skilled artizans who converted his plans into glowing, shining things of beauty and utility; powerful prime movers that turned the wheels of industry in mill and mine and factory. I craved the opportunity of serving him faithfully for four years so that I might acquire sufficient skill to add one more leaf to the laurel crown which distinguished him as a great captain of industry.

What I actually said was, "Please, sir, I want a job in the machine shop!"

He told me kindly enough I did not have a chance in the world. He had a waiting list as long as the tail of a kite. However, he had an opening in the foundry. I could have that job, which he assured me was much more desirable than the one for which I applied. He claimed good molders always were in demand and on an average they made more money than machinists. He advised me to go into the foundry and interview the foreman who would attend to all the necessary details.

Later I found that the opening in the foundry was chronic. During the period I spent there, boys came, stayed for periods ranging from a week to six months and then disappeared. I was the only one who finished out the sentence.

As I entered the foundry the cool, calm atmosphere, the subdued light, the quietness which prevailed presented a pleasing contrast to the heat and glare outside. The men's feet made not the slightest sound in the soft sand as they moved about their work. What a contrast to the modern foundry with the constant staccato hiss of escaping air, the rattle and bang of the jolting machines, the rumble of the big traveling cranes overhead and the incessant rattle of the pneumatic chipping hammers. I conceived a liking for the foundry the first day I entered it and the partiality remains to this day. I liked the smell of the baking cores, the whiff of wood smoke from the ladles drying outside the door and above all I was captivated by the dexterity, nonchalance and skill displayed by the molders in removing the patterns from the sand. Three men drawing a pattern of a 6-foot gear wheel held my rapt attention to such an extent that I

THE THREE MUSQUETEERS! ALL FOR ONE!

scarcely dared to breathe until it was delivered safely from the sand.

In my estimation the performance was an example of the highest juggling skill and I listened in astonishment while one of the molders invoked the most blistering maledictions on the unfortunate head of the man who had made the pattern. All because one sand tooth, one tooth, mind you, out of perhaps 100, had collapsed. In my innocence I felt it would have been more appropriate if he had chanted a paen of praise and thanksgiving to find any of them standing. However, the manner in which he slipped two spare wood teeth into the mold and built up the sand tooth between them raised my admiration, if possible higher than before. He placed what I afterward learned was the blade of a long 1-inch lifter in front of the two teeth and then packed the cavity full of sand. Then he removed the lifter, shoved a slim 3-inch nail in the sand tooth near the top, smoothed the sand with a few deft strokes of a slicker and then apparently without taking the slightest aim expectorated a small quantity of tobacco juice so accurately and expertly that it fell on top of the sand tooth without staining in the least either of the two wood teeth. He could not have hit it more accurately if he had suspended a plumb bob from his teeth.

No person paid the slightest attention to me and I felt rather diffident in asking any one to point out the leader who exercised supervision over the various activities. Finally by a combined process of deduction and elimination I settled upon one man whose face was cleaner than that of any of the others. My opinion was somewhat strengthened by the fact that he wore a derby hat on the back of his head. Some of the others also wore derbys, but invariably the brim was cut away all around with the exception of a bill or beak in front to serve as a handle.

He also wore a pair of white moleskin trousers that extended upward to within about 6 inches of his arm pits. I learned afterward that he had brought these with him frae Glesga' on the banks of the Clyde. He had two pairs and by washing each pair on alternate weeks he came forth brave and shining every Monday morning. In this respect he presented a radical contrast to the remainder of the crew whose pants never were either washed or even mended with the exception occasionally of a slight effort to hold the more obvious rents together with a few 10-penny nails. Sometimes since, I have wondered if the physical well being of these hardy lads was not perhaps due to this practice of letting the fresh air circulate freely around their persons. The only flaw in the theory is that their heads constantly were

'TWAS THE DAY BEFORE PAYDAY

encased in the air tight kellys, except for the few hours they spent in bed and yet almost without exception they all sported perfect heads of hair. This point is respectfully referred to those bright young master minds in the foundry industry to whom all the mysteries connected with the ancient and honorable art of founding in metals are an open book.

However, all this is beside the point. I approached the man in the dip and the lofty pair of trousers, and being assured that he was indeed no other than the gaffer himself, I modestly made known my desire to enroll under his banner. Naturally, I expected he would subject me to a severe physical and mental examination to see if I was qualified for such preferment. Mentally I braced myself for the ordeal and decided to add a year or two to my age.

Apparently, the prospect of adding an additional unit to his crew impressed him but slightly. Judging by my own experience in later years he probably looked upon me as just another thorn sent along by the devil to torment him. When I told him that the big chief in the office had sent me in to him, he said, "Ah, well, if ye think ye can stan' it, ye can come in after dinner."

This casual, not to say precipitous acceptance, took away my breath. Many times since I have rambled into a shop looking for a job at any hour of the day and cheerfully hung up my coat the minute I had the good word, but at that time the idea of such haste seemed positively indecent. Besides the day was Friday and though I considered that I was no more superstitious than the next person, I thought I might as well be on the safe side. I suggested anxiously that if he could hold the position open until Monday I would be there without fail. He was a swarthy Scot with a pair of bold black eyes, but he favored me with a quizzical glance and said he would try to keep the shop running until I turned up Monday morning. He has been dead now for many years, but I have every reason to remember him with the kindliest feelings. A strict disciplinarian and a master craftsman, with an enthusiastic pride in his chosen calling, he planted the germ of emulation in my mind which helped me to keep my little nose on the grindstone during the period of probation. He left at the end of six months but I worked for him again several years later. That is another story.

Looking back now, my chief source of wonder is how I managed to exist and have a good time outside of working hours. For the faithful performance of my duties I received the magnificent sum of $100 for the first year. While undoubtedly this is a fabulous amount of money if considered in a lump, it did not look so impressive when figured out at an hourly rate of 3.19 cents and I never required any help to carry home my little envelope every fortnight containing $3.82, more or less.

Whatever little familiarity I may have with applied mathematics is directly due to intensive exercise during this early period. I was religiously docked for every ¼-hour I was late in the morning, but on the other hand I was credited with an occasional ½-hour overtime at night at a rate of time and one-half. It is readily apparent that on some of these variegated fortnights, some exceedingly involved and delicate figuring was required on my part to make

my anticipated earnings coincide with the amount handed me by the paymaster. I had to run the final line out to four decimal places to decide the rather nice point whether the company or I was entitled to the final cent. If the figure was less than 5 the company won. If it was over 5, I claimed the penny.

During the second year the stipend was automatically advanced to $115, the third year it was $130 and the fourth year I was financially independent on a gross income of $150. I stayed for a year afterward at a daily wage of $1.50. Although it was three times my former rate the injustice of this arbitrary rate setting rankled since I was doing the same work as the leading molder who received $2. At the close of the year I decided to fly away and seek my fortune elsewhere, where a man was paid for what he did and where wages were not based on his length of service. I notified the gaffer and as a result the old man invited me into his office for a private conference. He adopted the good old fatherly attitude and proved conclusively to his own satisfaction that I was just plain silly to leave a good home and a good job to adopt the precarious existence of a rolling stone. He said he intended to ignore precedent and would advance me to the top rate and then as a clincher he intimated that the next time the position was open he would give me the job of foreman.

DRUMMING UP BUSINESS DURING A DULL PERIOD

The proposition was tempting, but the lure of far away places was stronger and besides I decided a few years of travel was essential to rounding out my knowledge of the business. I turned the offer down and I can't say that I ever regretted the decision.

Last night when Bill dropped in to smoke a friendly pipe I asked his opinion on the relative advantages of a boy staying in one place and of rambling around.

"Well," said he, "I'll tell you. You might just as well ask me whether it is better to play the red or black on a roulette wheel. If a man had as many lives as a cat so that he might try them all over in turn, then probably—mind you I say probably—he might be able to answer that question to his own satisfaction. However, the possibility always remains that he would make a fizzle of all nine and then his opinion would be worth no more than yours or mine.

"That question of yours involves so many factors that you might work on it forever without arriving at a solution. Quoting examples will not prove anything. I know any number of men who started as office boys or apprentices and finished up as presidents or general managers of the same companies with which they began. I know an infinitely greater number of men who remained with the same company all their lives and never got beyond first base.

"In the same manner I could reel you off the names of dozens of men who started off with the idea of constantly shifting until they found something that suited them. They ended up as bums. Other men following the same course eventually fell into jobs that landed them at the top of the tree. After all is said and done, my dear lad, luck or just plain chance is the most powerful factor in shaping a man's destiny and you may lay to that until your jolly old hide is blistered.

"Just to show you how it works out I'll outline a chapter in the life of four men whom for convenience I'll call *A*, *B*, *C* and *D*. *A* was foreman in one shop and *B*, *C* and *D* were molders in a second shop. *B* and *C* were bright, intelligent men and first class molders. *D* was a faithful plodder who always said 'Yes sir' when the boss spoke to him. He was illiterate and without initiative and had an instinctive dislike to starting new jobs or of trying an old job in a new way.

"The foreman in the second shop left and *A*, *B* and *C* applied for the position. *A* was ruled out in the beginning because forsooth the officers of the two companies enjoyed pleasant reciprocal relations which they wished to maintain. If either *B* or *C* had been alone he would have been elected, but the presence of the two introduced a complication. Each was bitterly jealous of the other and it was a moral certainty if one was promoted the other would quit. Even if he remained it was felt that he would develop a spirit of antagonism fatal to efficiency and discipline. One good sore head nursing a grievance and impervious to ultimate consequences can wreck the morale of a shop crew faster than a drastic and unwarranted cut in wages. He is just about as valuable as a fox in a chicken coop. After due deliberation the Gordian knot was cut by the appointment of *D* and for a time all went merry as the proverbial marriage bell. The superintendent assumed active control of the shop and *D* went about timidly, happy and grateful and said 'yes sir' more frequently than ever. *B* and *C* remained on the job, but they scornfully ignored him and their example was followed more or less by the other employes. Gradually the superintendent discovered that instead of a staff on which he might lean, he simply had added to his worries by acquiring a clinging vine.

"What the ultimate result would have been if conditions had remained stable it is impossible to say, but a general strike broke out and effected an adjustment. Here is another instance of how the element of chance upsets the most carefully balanced apple cart. Before the smoke of battle cleared away *A* accepted a better job in another town. *B* promptly annexed the vacant position and when the second shop resumed operation *C* was appointed foreman.

"What about *D*? Well you know when you want to get rid of a man, one excuse is as good as another.

(*Concluded on Page* 72)

Coke Causes Leaky Castings

Theories Tried in an Experimental Cupola and in Full Sized Units Proved That Soft Coke Is Responsible for Coarse Open Grain Iron

By James A. Murphy

ONCE upon a time, not to be too specific, within the past 20 years, I was handed a wallop that virtually knocked whatever ego I possessed out into the ambient atmosphere. At that period I used to feel rather cocky and confident of my ability to mix and melt iron to suit any important specifications. Success was so universal that I was contemplating crediting myself with a sixth sense for such trivial matters when this wallop was handed me periodically for about six months.

After consulting many of my practical friends without avail, also the few experts abroad in the land at that time, recollection that I once was an inmate of the British Isles prompted me to exercise the glorious old ancestral prerogative. When any problem bears too heavily on your chest, write to the *Times* about it. I wrote a description of my most poignant affliction for THE FOUNDRY and it started quite a little controversy. I have not preserved any of the several solutions of the ailment offered at the time but the gist of my contemporary consolers advice resolved itself into the composite conclusion: I was manipulating affairs in some manner to transform manganese sulphide, the usual form in which manganese exists in gray iron, into manganese carbide. This rare metallurgical bird of ill omen, I later discovered, wings its way foundryward with shipments of soft, underburned or overburned coke, perches on the cupola and from this point of vantage flaps its wings and mockingly screeches *cock-a-doodle-do* at the best of us.

Result of Observation

Chemical formulas may explain the transformation of manganese sulphide to manganese carbide, but what causes this transformation in the cupola never has been sufficiently elucidated to set the problem aside as solved. Extended observation among foundries for the past two years showed this trouble bobbing up here and there with all the surrounding elements of mystery that confronted me at one time. I never have been convinced that the transformation of elements takes place at all and I never pursued the solution of the troublesome problem from that angle. I believed, and with good reason, that iron in melting absorbs not alone more carbon from soft than from hard coke, but absorbs it in larger flakes, large and variegated enough on some occasions to make a casting look, after machining, as if it were troubled with ingrowing fish scales. Instead of pursuing any will-o'-the-wispish theories, I centered my attention on coke and in due course a shipment arrived that was badly overburned. The overburned portion of it analyzed about 94 per cent fixed carbon.

I used this coke alone in a small cupola and melted enough iron for a few small cylinders. They were so coarse grained that water came through them at all points under a few pounds pressure. The surface of the iron could not be finished with the sharpest tool nor by grinding. The 25 per cent steel mixture was fairly hard, about 1.50 per cent silicon, under 0.30 per cent phosphorus, manganese 0.70 per cent and sulphur 0.09 per cent. That overburned or soft coke would cause open grained and relatively porous castings, was only mildly suspected at that time, but later experiment and observation has confirmed the suspicion into a well formed and definite conclusion.

Old boys in the game must have had some well founded suspicion of soft coke for they demanded what is now only a memory, 72-hour coke. They did not always get it, but so long as the coke was hard, heavy and well burned, they did not know the difference, and it might as well be admitted that it made no difference either. In recent years more trouble is caused by overburned than by underburned coke and this is true of the beehive as well as the by-product ovens. However, more reliance can be placed on by-product coke. Most of the works generally produce excellent fuel for cupola purposes.

With the same irons, melted under the same conditions as formerly, but with a hard coke, I produced the same castings that in the process of machining took a glass like finish. Feeling positive that I had discovered the root of the trouble and acting on the principle that sufficient unto the day is the evil thereof, I did not experiment any further at that time.

Sometime later when the episode was little more than a lingering memory, my firm received an inquiry and specifications calling for a hard, coarse grained iron. At first glance the specifications seemed to be in direct violation of the laws of nature governing such things as cast iron, but as the prospective contract ran into heavy tonnage with the prospect of large future business, it was worth some thought.

Sample Casting

With nothing but overburned coke borrowed for the occasion, the little experimental cupola was used to melt a charge of the lowest grade of an off malleable pig iron about 0.70 per cent silicon. A full section of the required casting was made, machined, cracked to better demonstrate the grain and forwarded to the foreign customer for critical engineering inspection. In due course it was pronounced the *finest ever* and we were notified we could have the order if the cost of this most excellently suitable of metals for the particular purpose at hand was not inordinately high. Here was a new found market, without even competition. The reader safely may bet a silk hat against a salt herring that past loss and misfortune were repaid with usurious interest.

Two bad cases of this class of porous castings recently were called to my attention in shops over 500 miles apart where but slight chance existed of using basic materials from the same source. One was using by-product and the other beehive oven coke. Both shops had first class foundrymen and one of them in addition had a chemist of national reputation. The trouble was a brand new one to them and they were completely lost at sea for a cause or a remedy.

Both shops had plenty of overburned coke in their bins. By stopping the use of the overburned fuel and substituting good well burned coke, which fortunately was on hand in the rear and bottom of the bins, the trouble

was stopped immediately in both cases.

Manganese carbide, if such it be, asserts its presence in a much more pronounced manner in heavy and medium weight than in light castings. Quick setting of the metal in lighter castings decreases its visibility, so to speak, but I have traced many leaks to it in automobile cylinders. A low blast will ameliorate the condition to some extent but its entire elimination only can be accomplished by removing the cause.

Purchase To Specification

The purchasing agent for one foundry had his wings clipped nice and short and he will not be so alert or so keenly disposed in the future to purchase every cheap commodity proffered him for the foundry end of the business. In future he is to purchase only on the foundryman's specifications, and common sense should tell anyone that this is only as it should be. There is a world of difference in the quality of materials offered for foundry purposes, and purchasers should remember that while a cat may have as many teeth as a tiger there is a vast difference in their application on the job.

Association Holds Meeting

AT A luncheon which followed the fifth annual meeting of the British Cast Iron Research association at the Hotel Cecil, London, on Dec. 14, Sir Frank Heath, secretary of the department of scientific and industrial research, quoting from a recent speech by Sir Alfred Mond, said that the Germans have reduced the production cost of pig iron by lowering fuel costs 19 per cent. He also emphasized the importance of low temperature carbonization of coal, and stated that this process only will be possible commercially when cast iron retorts necessary to the process can be made to withstand the temperatures involved. When this is accomplished, the foundry industry will receive a considerable numbers of orders for making these retorts. At the meeting which preceded the luncheon, the fifth annual report was presented. Mention was made of the amalgamation of the association with the Falkirk Technical institute which becomes the association's Scottish laboratory. The present membership of the organization is 294. H. B. Weeks was re-elected chairman of the council, and F. J. Cook, J. T. Goodwin and O. Stubbs were re-elected vice chairmen.

During the past year research investigations by the association were carried on in the laboratory of the association, in several university laboratories and in the National Physical laboratory. The practical side of investigations involved in making castings is conducted at members' plants. Mechanical and chemical tests are performed at the Birmingham laboratory. Three applications for patents were applied for and one of these has been granted. This patent specification is claimed to cover some remarkable improvements in malleable cast iron by the reduction of grain size which persists through the annealing process.

In conjunction with the Birmingham branch of the Institute of British Foundrymen the association organized a meeting on foundry education and apprenticeship which was addressed by Eugene V. Ronceray, Paris, France. The meeting called for the formation of a committee to evolve a national policy, and the association is exploring the possibilities of success, should such a body be formed.

The work of the main committee No. 35 of the British Engineering Standards association has been continued and a number of meetings held during the year. Specifications for black-heart and white-heart malleable iron are in print and the specification for gray iron virtually is completed. Completion of these specifications will mark an important stage in the progress of the foundry industry which will possess general specifications for the first time.

Special Iron Needed for Diesel Castings

Question: We have contemplated entering the diesel engine construction field, but have been told that the castings involve the use of a special kind of iron and exceedingly expert foundry practice. We shall appreciate an expression of your opinion on these points.

Answer: When you refer to diesel engines we presume you only meant the cylinders, cylinder heads, pistons and linings. The bed plate, columns, flywheel and other parts are not exposed to severe heat or strain and therefore present no unusual features. The diesel engine as you probably are aware originated first in Germany. Foundrymen over there experimented for a considerable period before they finally developed a metal that would yield maximum service in the cylinders and other related parts. Eventually they hit upon a variety of cast iron and a method of casting it which they claim is more nearly ideal than any other. It is a low carbon, white iron poured into a heated mold to produce a metal known as pearlitic iron. That is an iron in which all the carbon is in the pearlitic form instead of the usual two divisions, combined and graphitic carbon. Several British and a few firms in this country use a modification of the same process.

Many makers of diesel engine castings both here and abroad use a stiff semisteel mixture—25 to 40 per cent—depending on the size and metal thickness of the casting. The main requirements are low carbon, phosphorus and silicon. Sulphur and manganese give no trouble, because they generally come right automatically on account of the proportions of the other elements. The principal raw materials are malleable pig iron and steel scrap. Several foundrymen report satisfactory results from the use of a special pig made by a prominent eastern producer.

Up to ½-inch thickness of metal a suitable analysis is: Silicon 2.30 per cent, sulphur under 0.10 per cent, phosphorus 0.20 to 0.30 per cent, manganese 0.70 to 1.00 per cent. For heavier sections the silicon is lowered but the other elements remain about the same. Heating the molds is optional. Some foundrymen do it and others do not. This, like many other features in the manufacture of these highly tricky castings depends on local conditions. Any person who has not had a wide metallurgical and practical foundry training is bound to burn his fingers on this job.

Make High Grade Nickel

A new grade of electrolytic nickel is being produced at the Port Colborne, Ont., plant of the International Nickel Co. This new nickel is claimed to have a purity of 99.90 per cent and will be carbon and sulphur free. Present capacity for production of electrolytic nickel is approximately three-quarters of a million pounds per month.

Temperature Causes Growth

Study Phenomena Resulting from Repeated Heating and Cooling of Special Alloy Cast Iron in Service

By J. H. Andrew and H. Hyman

CAST iron is perhaps the most complex and least understood of all iron-carbon alloys. It is only to be expected that, with such a multiplicity of variables involved, including not only the different elements present, but also temperatures of casting and rates of cooling knowledge on the subject can be but empirical. Therefore, it is not always possible to compare the work of different observers in the hope of complete agreement. However it is well known that gray irons grow and white irons do not, when subjected to repeated heatings and coolings, while Carpenter and Rugan have proved that silicon increases the total growth by an amount proportional to the percentage of that element present. It also is well known that the transformation of combined into graphitic carbon contributes toward this permanent expansion. While these statements represent generally accepted qualitative facts, it cannot be said that the actual mechanism of growth is fully understood. Consequently it is difficult to diminish the troubles that arise from this change in volume. Insofar as the engineer is concerned, growth may be classified into two classes; namely, that which occurs below the lowest critical point, which is of importance to diesel engine design; and, high-temperature growth, which has its bearing upon such problems as are connected with ingot molds and general furnace structures.

This paper only relates to high-temperature growth. The outstanding work upon this subject is that of Carpenter and Rugan,[1] and Carpenter.[2] These authors believed growth to be due almost entirely to oxidation of the silico-ferrite the oxidation being brought about by the air which diffuses into the interior of the mass by the graphite flakes which serve as the channels for conveying the air. They showed that white irons and carbonless silicon iron as long as they remain in that condition do not grow. While graphitization of the combined carbon undoubtedly contributed toward the ultimate growth, attention was drawn to the theoretical smallness of this effect. One of the most remarkable features of the work of these authors was the incompleteness of carbon elimination after maximum growth had taken place, namely, after fifty heats.

Due to increased temperatures employed in machines and apparatus where castings are used, the problem of the growth of cast iron under these new conditions is important. The authors of this article, which is abstracted from a paper presented at a meeting of the British Iron and Steel institute, held at the Institute of Civil Engineers, London, Eng., give the results obtained and some of the difficulties encountered in investigating this problem.

1 Carpenter and Rugan, *Journal of the Iron and Steel Institute*, 1909, No. 11.
2 Carpenter, *ibid.*, 1911, No. I.

The present work was carried out in order to ascertain: Whether the presence of silicon is a necessary factor for growth; what happens to the graphite at the end of fifty heats; and whether growth can be eliminated or retarded by the presence of certain special carbide forming elements, such as chromium, and vanadium in small quantites.

A series of ten castings was made in the laboratory, by melting Swedish pig iron along with the special elements in a 20-pound graphite pot, heated by a gas injector furnace. The metal was cast in dry sand the form of round bars of 1¼-inch diameter, sufficient heads being left on the castings to produce sound sections of the lengths required. The bars were taken from the molds when cold, cut to length and machined so as to give uniform section of 6 inches long and ⅞-inch diameter. The complete analyses of all bars is given in Table I.

The growth experiments were carried out by heating and cooling the bars in an electrically heated muffle furnace with an open top, the bars being covered lightly with asbestos wool, which enabled a uniform temperature to be maintained. The temperature of the furnace was raised

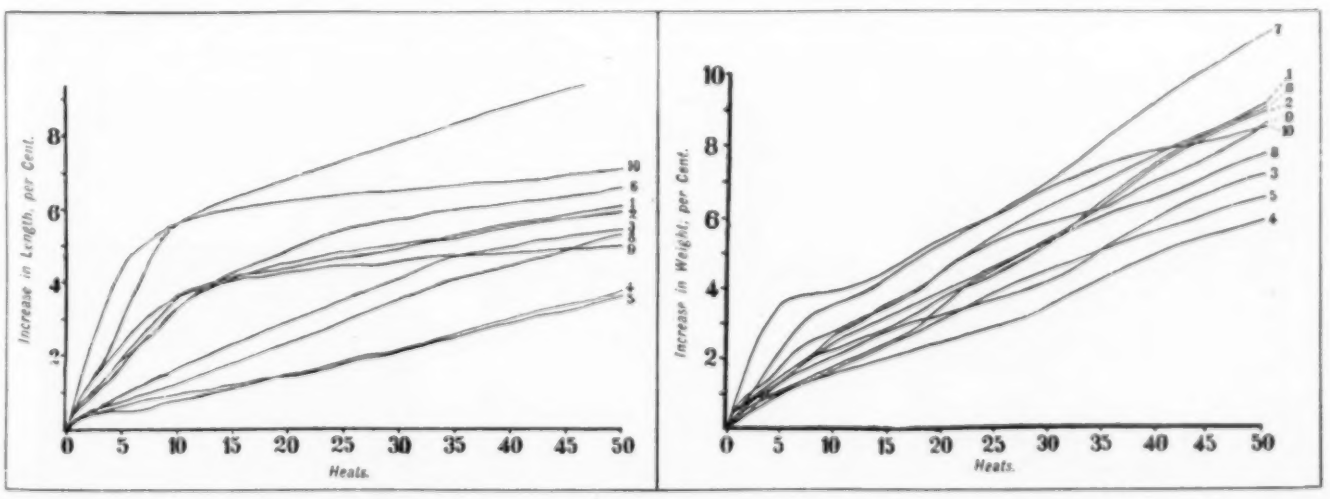


FIG. 1—SHOWS THE RELATION BETWEEN THE NUMBER OF HEATINGS AND THE GROWTH IN LENGTH IN PER CENT. FIG. 2—WITH AN INCREASE IN THE NUMBER OF HEATINGS A STEADY INCREASE IN WEIGHT IS NOTED

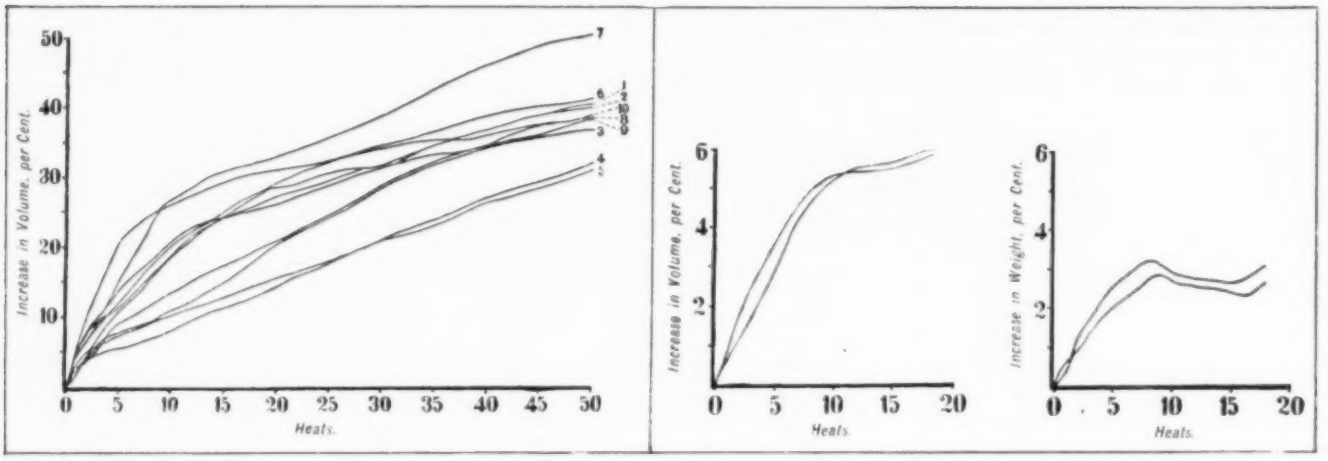


FIG. 3—LEAST VOLUME GROWTH TAKES PLACE IN IRONS NOS. 4 AND 5 DUE TO HIGH CHROMIUM AND MANGANESE CONTENT. FIG. 4—IN GRAY IRON THE FIRST STAGE OF GROWTH IS RAPID. AFTER THE OXIDATION OF THE FERRITE, GRAPHITE BEGINS TO OXIDIZE AND THE GROWTH IS MORE GRADUAL

to 900 degrees Cent. at each heating, and allowed to remain at that temperature for 15 minutes before cooling. Alteration in length and diameter was measured by a micrometer gage after each heat for the first 20 heats, and after every third heat for the remaining heats.

Table I

Chemical Analysis of Test Bars

No.	Combined Carbon	Graphite carbon	Graphite carbon	Silicon	Manganese	Chromium	Molybdenum	Vanadium	Nickel	Aluminum
1	3.49	0.33	3.16	1.16	0.56	...	...	...	...	...
2	3.33	0.32	3.01	1.31	0.61	...	0.58	...	...	...
3	3.21	3.21	...	1.58	0.59	0.49	...	...	...	...
4	3.26	3.26	...	1.37	0.56	1.19	...	...	...	...
5	3.67	3.67	...	1.49	1.83	1.19	...	...	...	...
6	3.01	0.36	2.65	1.45	0.60	...	...	0.25	...	...
7	3.60	0.29	3.31	1.15	0.55	...	...	...	2.88	...
8	3.44	Not estimated		1.45	0.56	0.69	...	0.38	...	...
9	3.89	0.31	3.58	0.43	0.68	...	...	...	...	1.16
10	3.98	0.14	3.84	0.64	0.63	...	...	...	...	3.07

Iron No. 1, silicon 1.16 per cent, manganese 0.56 per cent, represents a normal sample. This will be compared with No. 7, containing the same silicon and manganese content, and an addition of 2.88 per cent nickel; No. 9 with silicon 0.43, manganese 0.68, and aluminum 1.16; and No. 10 with silicon 0.64, manganese 0.63, and aluminum 3.07. With the exception of No. 1, these irons in addition to silicon contain an element, such as nickel or aluminum, which acts similarly to silicon in bringing about precipitation of the graphite from combined carbon.

Growth curves are shown in Figs. 1, 2 and 3, giving the increase in length, weight, and volume. The percentage increase in these factors is plotted against number of heats.

The difficulty of computing true volume figures will be appreciated, owing to variation in diameter at different parts in the bars after growth. The graph is given that a rough comparison may be made with the work of small quantities. Vanadium, No. 6, in small amounts, was ineffective in either promoting or retarding growth. Small additions of chromium, either in the presence of vanadium or manganese, showed an appreciable retarding action. No. 4 with chromium 1.19 per cent and manganese 0.56 per cent, and No. 5 with chromium 1.19 per cent, manganese 1.83 per cent, grew less than any other sample tested. This was to be expected, in view of the entire carbon content being combined. In the higher chromium irons the growth curve was almost linear, the first portion of rapid growth found in the gray irons being missing. As growth in these irons proceeded, an oxidized ring, gradually increasing in magnitude after each heat, was noted. After 50 heats a central core of more or less unoxidized material still remained. However, the similar character to that of the gray varie-

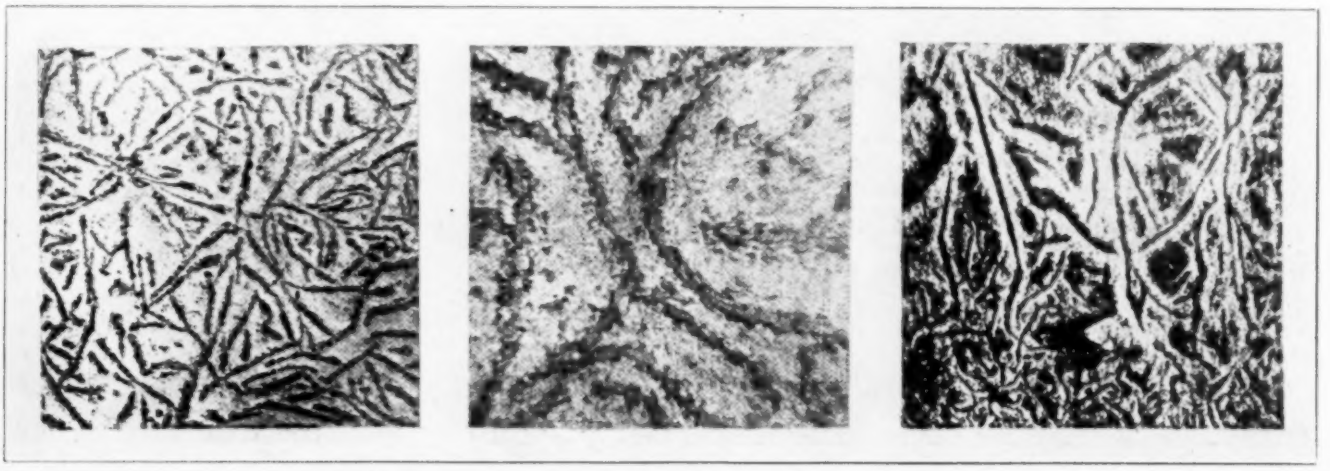


FIG. 5—SHOWING THE STRUCTURE OF ALL THE GRAPHITIC SAMPLES AFTER 50 HEATS (X 60). FIG. 6—SAME AS FIG. 5 EXCEPT AT 450 DIAMETERS. FIG. 7—MICROSTRUCTURE OF EXTREME EDGE AFTER 6 HEATINGS (X 60)

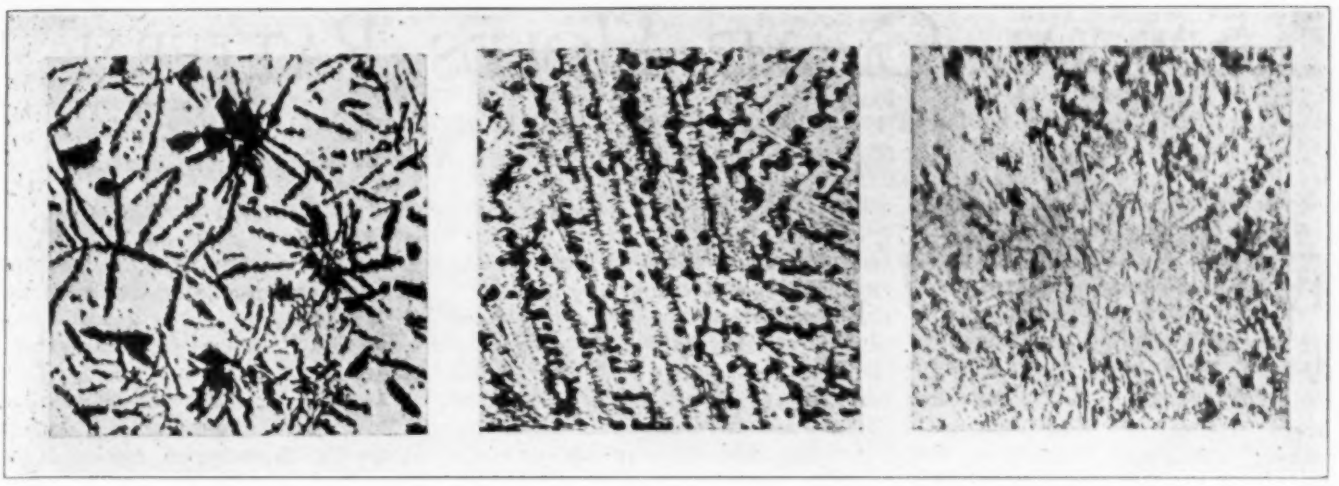


FIG. 8—AFTER 18 HEATS THE CORE HAS THIS APPEARANCE (X 60). FIG. 9—ORIGINAL STRUCTURE WITH CARBON IN COMBINED FORM. FIG. 10—OUTER PORTIONS AFTER 50 HEATS SHOW OXIDE FORMATION

ties, growth being preceded by graphite deposition. Typical micographs of these irons are shown in Figs. 9, 10, and 11. Fig. 9 is the original structure, and shows that all the carbon is combined. Fig. 10 is of the outer portions after 50 heats, and displays oxide formation. Fig. 11, taken from the inner core, shows both combined and graphitic carbon. That graphitization preceded growth is evidenced by its appearance in the central core, in which the carbon is but slightly reduced from its original value. The authors are inclined to believe that this graphite forms a gaseous reaction suggested by Honda and not through the direct decomposition of the iron and chromium carbides.

While chromium does retard the rate of growth to a great extent and the total growth, the practical application of chromium irons is limited on account of their hardness.

Fig. 12 shows the oxide on the outer skin of the bars. Its penetration into the former graphite channels is seen clearly.

The types of growth curves obtained by heating gray and white irons 50 times to 900 degrees Cent.

Table II

Analysis of Irons After Fifty Heats

No.	Total carbon	No.	Total carbon
1	0.06	6	0.01
2	0.02	7	0.03
3	0.11	8	0.05
4	{ 0.05 (outer ring)	9	0.04
	{ 3.08 (inner core)	10	0.04
5	Not estimated		

Other elements all showed slight loss.

Analysis of Irons after Different Heats (Carbon Per cent.)

No.	As Cast	Sixth Heat	—Eighteenth Heat— Outside	Inside	Fifty Heats
7	3.60	3.29	0.19	3.77	0.03
10	3.98	3.41	0.09	2.16	0.04

are similar in all respects to those obtained by Carpenter and Rugan.

Nickel and aluminum, when added in sufficient quantities, bring about growth in a manner similar to that brought about by excess of silicon.

It is suggested that these elements, nickel and aluminum, increase the ultimate growth and rate of growth, not because of their being highly oxidizable metals, nickel being less oxidizable than either iron or any of the special elements added, but due to their producing a coarsening effect upon the graphite. The graphite flakes become more bulky and provide wider and deeper channels for the easier penetration of air.

Growth in gray irons takes place in two definite stages, as found by Carpenter, the first or rapid stage being brought about by oxidation of the ferrite, the carbon being at first but slightly oxidized. When sufficient oxide has been formed, carbon then becomes oxidized, causing the entire channels previously occupied by graphite to become filled with oxide, which serves to seal them. The gradual and continued growth after this stage has been reached can be due only to the slower penetration of the oxide into the body of the material. It seems probable that the oxide at the outer portions becomes converted into a higher oxide, which serves to further oxidize the unaffected portions. Whether the alleged reversible transformation, $Fe_3O_4=3FeO+Fe$, has any bearing upon growth has not been considered, work is in progress which deals with the transformations of the oxides of iron.

Chromium when added in sufficient quantity, 1.5 per cent considerably retards and reduces growth, but does not prevent it. Growth is always preceded by graphitization. This again agrees with the deductions of Carpenter.

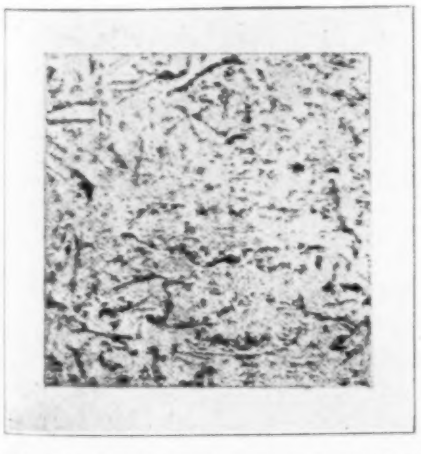


FIG. 11—INNER CORE SHOWS BOTH GRAPHITIC AND COMBINED CARBON (X 60)

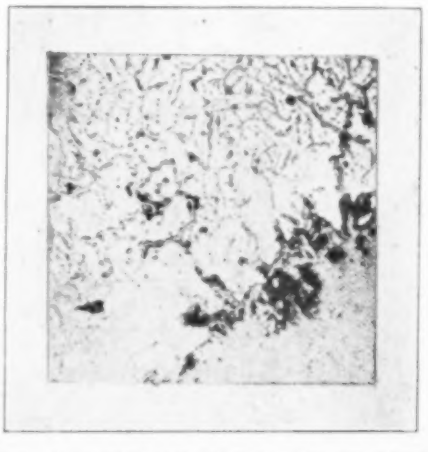


FIG. 12—OXIDE ON OUTER SKIN OF BARS PENETRATES INTO FORMER GRAPHITE CHANNELS (X 60)

SPECIAL CLAMP HOLDS PATTERN

Shows Construction and Application of a Toggle Jointed Steel Clamp Used in Connection with a Corebox on a Rollover Machine

By H. N. Tuttle

EITHER the ordinary home-made foundry clamp, steel or cast iron or the purchased steel bar screw clamp is satisfactory for the great majority of foundry operations, but occasionally a situation arises where neither of these clamps is entirely satisfactory. Sometimes they are of no possible use. Some other device must be employed.

A case of this kind came up recently where it was found that in clamping the cast iron dryer to the steel faced corebox mounted on a large rollover machine, it was practically impossible to entirely prevent the dryer plate from slipping. No doubt this was due to the metal to metal contact of the clamp and dryer at one end of the clamp, and the clamp and molding machine platen on the other end. Also to some degree it was due to the necessarily long clamp.

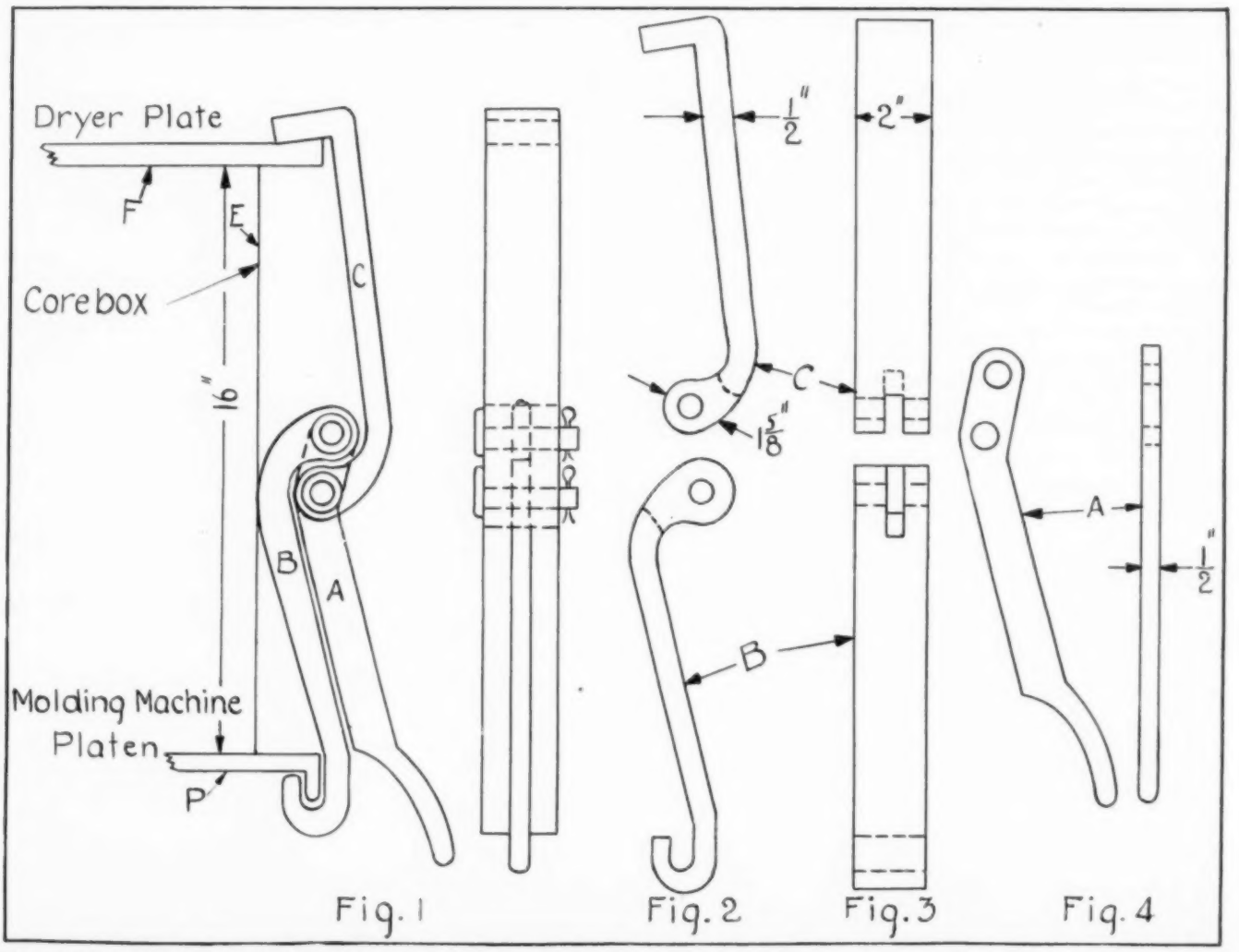
To meet these conditions, a cast steel clamp was designed which has proved so satisfactory that other sizes, with different shapes of special jaws have been made for other jobs where the necessity actually was not so keen and pressing.

Details of the clamp are shown in Fig. 1, in which *P* represents the molding machine platen, *E* the side of the corebox, 16 inches deep over all and *F* is the core dryer plate.

The clamp is composed of three members *A*, *B* and *C*. The handle *A* is operated like a pump handle and the links *B* and *C* pass by their dead centers exactly after the manner of the hand stripper levers in the old Pridmore molding machine. This gives a powerful, quick acting and self locking action, for clamping and unclamping.

While the clamp is nonadjustable in itself and should be made specially to fit the job, still it can be adjusted to fit different jobs within a definite range by fastening a block of the proper thickness to one or other side of piece to be clamped.

Detail drawings of the separate members are shown in Figs. 2, 3 and 4. The parts illustrated are made of steel stock about ½ x 2 inches. Frequently it is desirable to change the coreboxes several times a day where a rollover machine is employed for making large cores. Something more rapid than the standard clamping device is desirable for attaching the corebox to the machine platen.



FIGS. 1 TO 4—DETAIL OF THE VARIOUS PARTS OF A SPECIAL STEEL SELF-LOCKING CLAMP DESIGNED FOR USE IN CONNECTION WITH A COREBOX ON A ROLLOVER MACHINE

Two satisfactory methods are shown in Figs. 5 and 6. In each of these illustrations the same letter is employed to designate a part whether it is shown in a side or plan view.

Dovetail Strips

The corebox *J* in Fig. 5 is shown by a dot and dash line. The rollover platen is shown at *K*. The plan view simply shows the molding machine platen with the corebox removed. Parts belonging to the corebox itself are shown by dot and dash lines.

Two long dovetail strips *AA* are shown firmly fastened to the platen by screws. They are planed on the edge at a dovetail angle of about 60 degrees as shown in the bottom view and also are located on the platen at an angle of about 5 degrees, as shown in the upper or plan view. Similar steel strips *BB* are fastened firmly to the bottom of the corebox.

It readily will be seen that if the corebox is merely set on the platen in a position a few inches forward of its regular position and then is pushed back until the dovetails fit both sides, it will be fastened firmly to the platen. To prevent the corebox from slipping out, either during the jolting or rolling over process, it is necessary to hold it in its proper position with some other clamping device.

A ratchet dovetail clamp is shown at *C*. After the corebox is in position, this clamp *C* is slipped in its dovetail seat formed by the plates *D*, *E* and *F*, screwed to the platen itself. The dog *H* engages the ratchet teeth cut in the edge of the clamp bar *C* and prevents the bar from slipping back. The final small adjustment is made through the hand wheel *G* which firmly presses the corebox into the desired position. The spring *I* holds the dog *H* in position until it becomes necessary to remove the clamp, which is done readily by turning back the hand wheel *G* a few turns and at the same time moving the handle of the dog *H* toward the center of the platen. The clamping bar *C* now may be slipped back or out entirely as desired. A long series of teeth on the edge of the bar *C* accommodates a wide range of sizes in coreboxes without necessitating a long screw on the hand wheel *G* which would be in the way of rolling over a wide corebox. The various dovetail strips are made from ½ x 3-inch steel stock.

Another somewhat similar device is shown in Fig. 6 where the platen is shown at *L* and the corebox in dot and dash line at *M*.

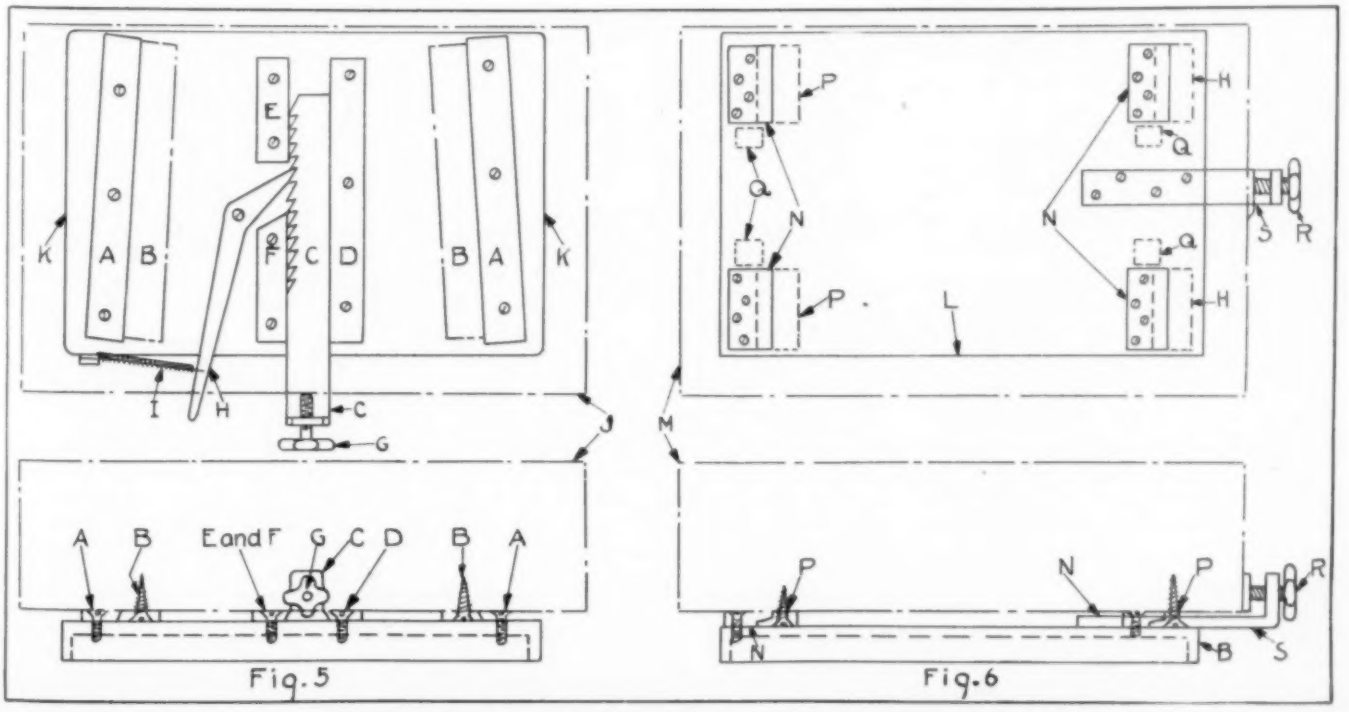
Four pieces of steel *N*, about ½ x 3 x 6 inches dovetailed as shown, somewhat differently from the clamping dovetails shown in Fig. 5 are screwed permanently on the platen of the machine in the rectangular position shown. Four similar pieces *P* shown in dot and dash line in the upper, or plan view Fig. 6, are fastened to the bottom of the corebox, in a reversed position so that the dovetails engage as shown in the lower or side view, when the parts are in proper clamping position.

Four steel blocks *Q* also are fastened to the bottom of the corebox so that there is little if any clearance between them and the platen dovetails *N*. These blocks prevent the corebox from slipping during the rolling process. The corebox is held in its dovetail position by the hand wheel *R*. The clamp bar *S* is screwed to the platen as shown.

In both styles shown in Figs. 5 and 6, proper templates for locating the dovetails on the bottom of the corebox should be kept in the patternshop so that at any time new boxes may be mounted to a perfect fit without the necessity of fitting to the machine itself. Quite probably in many cases, these clamping devices could be attached to the bottom of pattern plates with equal success. Up to the present they have not been tried out in this manner in the shop where they were designed.

Publishes Bulletin

The sixteenth annual report of the bureau of mines recently has been published. The report presents a summary of the various activities engaged in by the bureau during the past fiscal year. Many technical bulletins on the work accomplished have been published and others are on the press. Noations of the bulletins are made throughout the report so that those interested may obtain copies. Most of the governmental metallurgical investigations are carried on by this bureau in various parts of the country.



FIGS. 5 AND 6—PLAN AND SIDE VIEWS OF THE APPLICATION OF TWO SOMEWHAT SIMILAR DEVICES FOR HOLDING A COREBOX TIGHTLY GRIPPED IN DOVETAILED SLIDES ON THE PLATEN OF A ROLLOVER MACHINE

Patterns Need Seasoned Wood

Tests Should Be Made To Determine If Moisture Content of Lumber Was Removed Without Causing Strains in The Material

By J. M. Haley

FOUR essential qualifications of a good pattern are that it will not check or split easily; that it will not warp; that glue joints will not open; and that it is light and durable.

Wood, when used in patterns, is subjected to a severe test in the foundry with the alternating conditions of heat and humidity, incident to the generation of steam and moisture during the hours of pouring. To obtain patterns which comply with the essential qualifications it is necessary to know something of the properties of the woods more commonly used.

Seasoning is the most important step in making lumber adaptable for patterns, since the difficulties encountered in the foundry are traceable directly to faulty methods of drying. Two methods of seasoning are used, namely, air and kiln drying. Air seasoning consists merely of piling the lumber out in the open for a period varying from one to two years and thus subjecting it to the drastic action of sun, wind and rain.

Kiln drying is a process wherein moisture is removed from the wood by scientific application of heat. In that process control may be exercised in eliminating the defects and degrade due to seasoning. The movement of moisture within wood is effected by three controllable factors, namely, temperature, humidity and circulation. A constant application of these three forces in proper proportion is essential to the successful evaporation of moisture from lumber.

Moisture Is Diffused

Circulation of heated air around the surface of a board causes the exterior fibres to lose their moisture. As soon as evaporation from the surface commences, a moisture gradient is established. By making the wood drier at the surface a movement of the moisture is started from the interior outward.

Relative humidity of this heated air in the kiln directly affects the rate of diffusion of moisture from the lumber. That is to say, if the air is saturated at 150 degrees Fahr. no additional moisture may be taken up and hence no evaporation from the lumber. However, if the air is only 50 per cent saturated or has a relative humidity of 50 per cent then 50 per cent more moisture may be held by the air. This is supplied by the lumber.

If the drying at the surface progresses too rapidly, a rapid evaporation will take place from the surface to the atmosphere with a slower diffusion of moisture from the interior to the surface. The surface fibres, because of rapid evaporation, shrink more quickly than the core, and in so shrinking squeeze together the interior, creating in it, a state of compression and, in the fibres, a corresponding state of tension. The technical name for this state of affairs is *case-hardening* and is a source of constant worry in patternmaking operations.

Relief for the situation lies in a steaming treatment which introduces more moisture into the surface fibres, swelling them and relieving the tension. The harmful conditions may be avoided and eliminated entirely if the

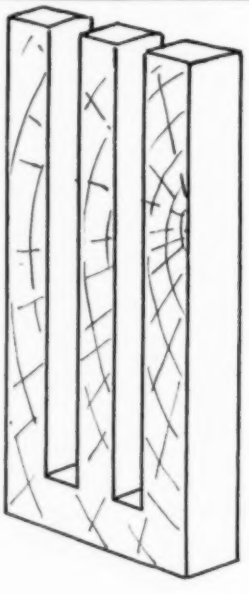


Fig. 1

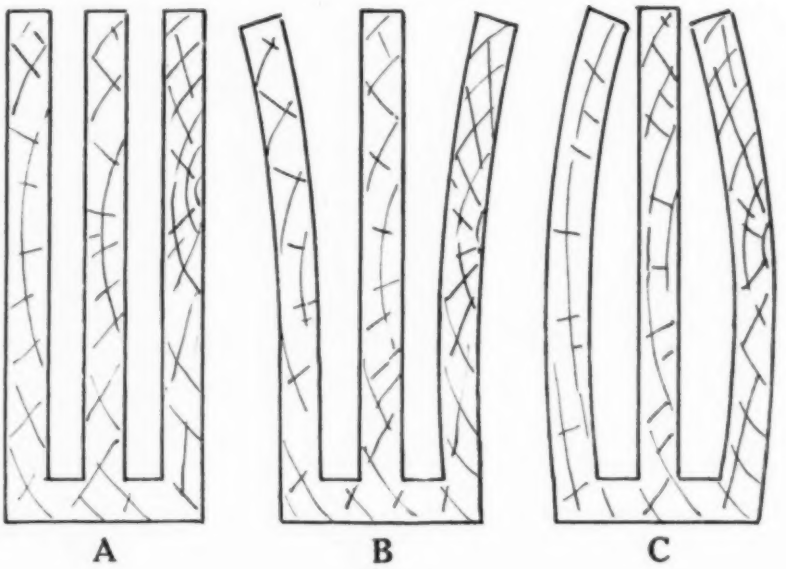


Fig. 2

THE PRONG TEST EASILY SHOWS THE STRAINS PRESENT IN THE LUMBER

relative humidity of the heated air is such, that the rate of evaporation from the surface to the atmosphere is equal to the diffusion of moisture from the interior to the surface.

As has been noted, the temperature of the air and the percentage of relative humidity therein, directly influence the amount of moisture that may be removed from the lumber. In the same manner, these factors determine the amount of moisture which a board will contain and, at the same time, be compatible with those atmospheric conditions. In other words, for a given temperature and relative humidity, there will necessarily be a definite moisture content in the lumber. Consequently, the first consideration is to kiln dry the lumber to that moisture content which will be most compatible with atmospheric conditions in the foundry, and thereby prevent shrinkage or swelling when the pattern is put into service. A moisture content of 10 to 12 per cent is most adaptable for foundry use.

If no attention is paid to the relation of relative humidity to the moisture content of the wood when the lumber is seasoned and an excessive surface evaporation is allowed to continue, the strains set up internally are sufficient to cause the fibres to pull apart or split. This defect is known as a *check* and is a prolific source of waste in lumber. Checked lumber will not make a good pattern because it immediately is evident that the stock is in a strained condition. The remedy for this is saturation of the surface of the board to relieve the strain.

Case hardening is the most common defect in seasoning. It is the cause of warping and opening of glued joints. The cause of case hardening primarily is the same as that of checking but to a lesser degree. If one can picture a cube of rubber pressed firmly from all sides by means of a clamp he easily may visualize the state of tension and compression that the wood fibres are in when excessive surface evaporation occurs. If no remedial action is taken and the lumber is allowed to find its way into the shop, the evil results of case hardening will follow. When the stock is planed the outer fibres are being removed. This relieves the compressive effect and allows the inner fibres to lose the moisture that is contained and in so doing, shrink and pull away from a joint or become so bowed that it is impossible to join two such pieces.

A simple method of determining whether or not the pattern stock is in a case-hardened condition is known as the prong test. This test is as follows:

Cut off a section 1 inch in the direction of the grain at a distance of 1 foot from the end of the plank. Make saw kerfs in the 1-inch section as illustrated in Fig. 1.

If the prongs remain straight, the stock is uniformly dry and there are no inherent strains, Fig. 2 *A*. If the prongs bend outward the outer fibres contain more moisture than the interior and the stock should be placed in a dry place to establish an equilibrium, Fig. 2 *B*. If the prongs bend inward the stock is case-hardened and not uniform as to moisture content. The amount of bending in the prongs is an index of the severity of the case hardening as in Fig. 2 *C*. The closer the prongs bend to the center the more severe are the strains and the more susceptible is the stock to warpage and open glue joints.

A moisture determination may be made by weighing a section cut ½-inch in the direction of the grain, drying to a constant weight and weighing after drying. Subtract the dry weight from the original and divide by the dry weight. The result is moisture precentage in terms of dry weight.

It is evident that the method of seasoning and the care exercised is of fundamental importance in the satisfaction of the necessary qualifications of good pattern lumber. Two simple tests will show whether the lumber has a correct moisture content and if the moisture is distributed uniformly, thereby giving assurance that the material entering into the construction of patterns will be best suited and not susceptible to common defects which contribute to expensive pattern replacement.

Expands Business by Building Outlets

(*Concluded from Page* 44)

the foundry in trip buckets similar to those shown in Fig. 7. Here, five large tumbling barrels made by the W. W. Sly Mfg. Co., Cleveland, are mounted in a straight line close to the columns which mark the dividing line between the central and one of the side bays. The barrels are loaded from a long platform on the center bay side and discharge their loads later into the side bay, which in this vicinity is floored with wood blocks and equipped with the necessary grinding and chipping machinery. Some of the smaller castings are cleaned in a sandblast chamber made by the New Haven Sandblast Co., New Haven, Conn. A dust exhaust system attached to the battery of tumbling barrels keeps the air clear in their vicinity.

1927 Safety Congress To Be Held

The sixteenth annual safety congress will be held at the Stevens hotel, Chicago, from Sept. 26 to 30 inclusive, according to a statement by W. H. Cameron, managing director of the National Safety council following a meeting of the executive committee.

The first four floors of the new Stevens hotel will be devoted to the convention and all meetings, banquets, luncheons conferences and exhibits will be held under one roof. Over 5,000 persons attended the convention held in Detroit last year and the 1927 convention is expected to attract more. The National Safety council has its headquarters in Chicago and is the parent association of the Chicago Safety council and 65 other affiliated accident prevention associations.

Gas Holes May Be Due to Several Causes

Question: We shall appreciate your opinion on the probable cause of holes which appear sometimes before, but usually after a cut has been taken off the upper flange on a shrouded gear or a flanged cylinder cast on end. These are poured from a semisteel mixture containing 15 per cent steel and we are wondering if the silicon content of 1.90 per cent is responsible for the trouble. Would the holes disappear if we used a straight iron mixture with a silicon content of 2.50 per cent? The holes are round and smooth which supports our contention that they are gas holes due to improper molding methods. We have been told the trouble is due to high sulphur and shrinkage.

Answer: You are quite correct in dismissing the hoary old high sulphur alibi for gas holes. For many years this element was the foundry scape goat, it was blamed for every defective casting where the least doubt existed. Hard spots, blowholes, cold shuts, shrinkage, cracks and warps. Although it was not blamed directly for drops, cuts, scabs, swells, crushes, or shifted joints it was regarded suspiciously. Under certain conditions high sulphur content is not desirable but it has no bearing on the produc-

tion or non-production of gas holes. For certain classes of castings a high sulphur content is a necessity. For example, chilled car wheel specifications call for a sulphur content of 0.14 to 0.18 per cent. You will not find many gas holes or any other kind in car wheels. Speaking generally, the shrinkage of iron increases with the lowering of the silicon content, but the difference in shrinkage between a 4-foot gear poured from an iron of 1.90 per cent silicon and one containing 2.50 per cent would not be appreciable and certainly would not account for the round holes to which you refer. Anyway, shrink holes present such a characteristic *drawn* appearance that any person who has seen both shrink and gas holes, will not mistake one for the other. To avoid any missunderstanding on this point let us hasten to add that the foregoing only applies where the casting thickness is uniform. Where variations exist in the casting thickness, for example between the rim and the arms of a wheel, a comparatively high silicon iron will reduce the danger of draws, shrinks and cracks. We are inclined to the opinion that if you check up on your molding practice you will find that something is causing the iron to boil or kick while it is rising in the mold. Remove this cause and no further holes will appear in the castings. It may be steam from a hard or wet mold, or it may be gas from an unvented or over bonded core. It may be a combination of all these. A close check on the progress of the mold and its behaviour during the pouring period should disclose the cause of the troubles.

Faked Foundry Facts

Take 'Er Up

Englishman Comments

William Jolley, representative of the British Cast Iron Research association, the Institute of British Foundrymen and the British Nonferrous association, who was one of the 125 delegates that attended the Detroit convention of the American Foundrymen's association and who has remained in this country since the convention visiting northeastern cities, in a statement to the *New York Times* Dec. 8, said that he was surprised at the freedom with which the American foundrymen disclosed the so-called secrets of their business and their specialized methods.

"Never before," he said, "have I encountered such open hearted confidence as during the five weeks of my stay in the United States." He noted that when British foundrymen have visited other nations in the past that their hosts were quite reticent in giving any information. The cordiality and open-mindness displayed here has made foreign foundrymen admirers of things American, he said, and the members of the international association hope to return for another convention in the United States.

Facing Produces Pitted Face on Casting

Question: The surfaces of my stove plate castings are covered with little pits and small holes and I am wondering if they are caused by dirt in the iron. Do you think that charging the gates and the iron recovered from the cupola drop, without tumbling, is responsible for the trouble?

Answer: In the great majority of foundries the remelt iron is charged in the condition in which it is gathered up from the floor. The advantage of cleaning the iron is that clean iron requires a smaller amount of coke to melt it and a smaller amount of limestone to flux it, than iron which is covered with a film of sand. In many cases the saving is so slight when compared with the time and power required to clean the scrap, that the majority of foundrymen do not consider it worth while. The condition of the iron has no bearing on the problem you have. The pitted face on your castings is caused by the facing sand and may be due either to the composition of the sand or the manner in which it is prepared. A high percentage of lime or clay in the sand will cause a mild boiling action of the iron as it passes over the surface. On heavy castings this would not be noticeable, because the iron remains liquid a longer time and settles down after the small bubb'es have subsided. Frequently the trouble may be traced to the manner in which the sand is mixed. New sand constantly is added to the heaps to maintain the bond and to compensate for the amount of sand that is carried away with the gates and castings. This sand usually contains an excess of bonding material, so high in fact that if the new sand was used by itself the metal would not lie against it. Where this sand is mixed with a suitable quantity of old sand in a mechanical device that thoroughly incorporates one with the other, the result will be satisfactory. Where the mixing action is incomplete, pellets of the new, raw sand are rammed against the pattern and cause the iron to boil later when it comes into contact with them.

Bill Speculates

(*Concluded from Page* 62)

He was told that he was suspected of sympathizing with the strikers, therefore he no longer could be considered for a position of authority. However, he was offered a job on the floor and of course he gratefully accepted. Now perhaps you can tell me how much push, perseverance, intelligence and ability had to do with these various appointments. You can start telling me if you like, but that is all the good it will do you. Go ahead."

"Well" I said "I am not prepared to start an argument at this time of night, but your reference to push and perseverance reminds me of a story I heard the other day. While an imported sky pilot was preaching the funeral oration over a gent lately deceased in the peaceful little hamlet of Hell Canyon, Arizona, two shots in rapid succession sounded outside. The undertaker tiptoed forth and in a few minutes he tiptoed back again. He leaned over confidentially to the chief mourner and with a bland smile on his face whispered, 'Well, I got them there two funerals!'"

WHAT OTHERS ARE THINKING

Abstracts Selected from the World's Foundry Literature

Describe Mold Drying Apparatus

Heat Economy of Mold Drying Apparatus in the Foundry, by Dr. Ing. A. Wagner and Dipl. Ing. A. Koch, Duisburg, Germany, Berein deutscher Eisengiessereien, Giessereiverband, abstr. in *Stahl und Eisen*, Oct. 28, 1926. An investigation of mold drying was carried out by the authors who found that moisture in drying molds rises upward as in open air. Corners and edges are dried harder and the transition from dry to wet sections in case of rapid drying is abrupt and not gradual as is assumed generally. With increasing dryness the specific heat consumption rises. To prevent *dead* spaces in drying ovens, the flue temperature must be lower than in the oven. From the standpoint of heat technic, heating with the upper draft only is wrong because the gases follow the shortest route to the stack. It is considered good practice to choke the chimney and work with a lower draft. Efficiency of drying ovens in general is low, and in some plants is only 20 per cent and often below 10 per cent. Radiation losses are high showing 42 per cent in the reports and one test was 56 per cent.

Direct combustion of coke and coke breeze produces a better distribution of heat in the oven. Blast furnace gas produces a moist heat while that from coke is drier and takes up more moisture. Increased air changes will overcome the disadvantage of moist heat. To burn large quantities of solid fuel in a given time, the grate surface and stack section must be adequate. A grate surface of 2 square meters should be allowed for each 100 cubic meters of drying space. A cross section of one-fourth the grate surface for the stack seems adequate. Charts for the construction and control of foundry drying rooms are presented. These are based on tests made and the experience of others and emphasize the necessity of temperature control. Tests made on portable systems do not always substantiate the impression of low thermal efficiency due to great losses.

Discusses Semi Steel

Remarks of an Old Chemist on High-Resistance Cast Iron, by Alex. Legrand, *Fonderie Moderne*, October 1926. Causes of the qualities or defects in certain special irons are still unknown. According to Alex. Legrand, in *Fonderie Moderne*, October 1926, the best known high-resistance iron is semisteel. However, the government plant at Indret, France obtains high-resistance cast iron without any addition of steel or other products simply by carefully blending different grades of pig iron. This requires the possession of considerable and well classified stocks. The author believes that the addition of special products in small amounts has a beneficial effect. He cites an old practice of adding a few grains of lead in the bottom of the ladle, which gives a better separation of the graphite. Certain French railroads specify that pigs should be remelted and recast before being used in the cupola in order to obtain a closer grain in the manufacture of locomotive cylinders. The author states that, far from being injurious, phosphorus, within certain limits, will increase the fluidity without decreasing resistance. The addition of steel increases resistance, but is the cause of difficulties of castings because of the rapid cooling property of the resulting metal. In that case remelting is recommended but expensive. In conclusion the author recommends melting at a high temperature because high-resistance cast iron is not as fluid as the ordinary grades and the final reactions should take place at about 200 degrees Cent. above solidification point.

Gives Tinning Method

The Tinning of Gray Iron Castings by Eng. Marnach, *Die Giesserei*, Sept. 11, 1926. Due to the graphite content of cast iron, a good clean metallic surface is lacking which causes difficulty in tinning castings. It is necessary to coat the surface with another metal and then apply the molten tin. Electrodeposition of pure iron, copper or other metals is a costly procedure and chemical deposition by use of an acid copper bath after cleaning the casting is cheaper. This problem of tinning is discussed by the author, and he gives the following operating details:

Sandblasted castings are immersed in a 15 to 20 per cent solution of hydrofluoric or hydrochloric acid at 80 degrees Fahr. until well etched. They then are washed and kept under water until ready for the copper bath. The copper bath contains 5 parts by weight of cupric chloride, 2½ parts of ferrous chloride and 2/10 part of potassium ferrocyanide. Amount of water is not given, but assuming a 10 per cent solution, 75 parts by weight of water will be required. Castings are dipped for 3 seconds and immediately placed in a heated bath of palm oil or under water to prevent oxidation which occurs rapidly in air. The palm oil bath is heated above the temperature of the tin bath. After being heated the castings are placed in the tin bath which has a cover of palm oil, tallow or zinc chloride. Open tank tinning baths heated by gas or other fuel are used. The furnace is constructed of steel plates lined with firebrick or other refractory. A steel-plate tank stiffened with angle-iron ribs contains the tin bath. Bath temperature ranges from 530 to 580 degrees Fahr.

Graphite Segregation

Kish Graphite in Cast Iron, by Prof. Bernhard Osann, *Stahl und Eisen*, Sept. 30, 1926. Forms of graphite in cast iron are the center of attention. Coarse-leaved graphite is claimed to weaken the structure of castings, and the author distinguishes this type of graphite by referring to it as *kish* graphite. Kish graphite is that which separates from the molten iron in contrast to mixed crystal graphite which separates durin the breaking up of iron carbides in solid-solution. Laboratory tests are not of much value because only small crucible charges are used and overcooling and undercooling play a large part in the graphite formation. The author considers the separation and influence of kish graphite by the various melting processes. Its appearance in special test cases is treated at length and the influence of cooling rapidly is especially considered. To prevent the formation of this type of graphite, it is recommended that the carbon content be kept as low as possible, and ways and means of doing this are suggested.

Presents Physical Tests

Sulphur Lowers Strength by W. Meigen and R. Stock-Schroer *Metal Industry*, London, Oct. 8, 1926. A number of experiments to determine the effect of sulphur on the physical properties of nonferrous metals and alloys were performed. The tests carried out show that a sulphur content below 1 per cent reduces the tensile strength from 5.2 to 70 per cent. Results are presented in the accompanying table.

Sulphur Reduces Tensile Strength

Composition	Copper	Zinc	Tin	Lead	Brass	Red Brass	Bronze	Tombac
Copper	99.14	.....	.....	.....	77.75	91.98	93.92	95.76
Zinc	.....	99.7	.....	.....	20.56	0.42	3.29	0.87
Tin	.....	.....	99.39	.....	0.28	3.97	0.84	1.83
Lead	.....	.....	.....	99.57	1.04	2.78	1.18	0.54
Sulphur	0.86	0.3	0.61	0.43	0.44	0.81	0.70	1.00
Ten. Str. T/Sq. In. Sulphur added	3.544	0.946	0.927	1.168	11.761	12.638	7.71	7.367
Without Sulphur	10.16-12.7	1.27	1.588	1.27-1.9	19.0-31.75	13.3	12.7	12.7
Decrease, per cent	70	25.5	4.16	26.4	53.7	5.2	39.3	42.0

The Shakeout

DAN M. AVEY, Editor

PAT DWYER, Engineering Editor
FRANK G. STEINEBACH, Associate Editor

CHARLES VICKERS, Nonferrous Editor
EDWIN BREMER, Associate Editor

¶ Teach the Youngster

ACCIDENT prevention work in every walk of life has been rendered exceedingly difficult through the inherent tendencies of the adult population to follow habits of carelessness learned in adolescence. Not so many years ago the dangers which beset the large body of ordinary individuals on this earth were not great and the chances of escaping accidents to live beyond the age of three score and ten were exceptionally high. Then came the mechanical age, which has eased the labors and increased the pleasures of mankind, but which also has made and multiplied dangers little dreamed of when father was a boy.

While the results accomplished by the various organizations, large and small, engaged in furtherance of safety, both in and out of industry, have been remarkable in preventing accidents which either kill or render the victim a cripple for life, even greater benefits should accrue in a few years from the safety work now being undertaken in the public schools in various parts of the country.

THE effort in Pennsylvania along this line may be taken as an example. Believing in the saying "Train up a child in the way he should go and when he is old he will not depart from it," school officials in that state several years ago started to place the teaching of safety in the schools on a sound pedagogical foundation by correlating the work with the teaching of regular courses such as civics, English, art and mathematics. After conquering the first problem, namely that of selling the teachers on the value of safety work in the schools, the Commonwealth set about to supply the teachers with books and pamphlets to aid in furthering the courses. Three field workers are sent out to confer with superintendents and supervisors on ways and means for initiating safety teaching. Greater interest has been created among the children through a magazine dealing with safety education, which is published 10 months during the year. Embryonic teachers in normal schools are given instruction in the methods of teaching children the rules of safety.

Undoubtedly the leaders in the safety movement are traveling on the road to success, for with the ideas of safety firmly instilled in the minds of the children of today, the grown ups of tomorrow will find less need for the admonition "Be Careful."

¶ Reducing the Unknown

IN A recent address delivered at a meeting of a number of groups of the Institute of British Foundrymen, J. E. Fletcher, who will be remembered as the contributor of the British exchange paper at the Syracuse convention of the American Foundrymen's association, commented pointedly upon his observations of American foundry practice.

After commending the advancement made in machine processes, notably in handling, sand preparation and delivery, molding and sand blasting, Mr. Fletcher mentions the control of core baking. He states:

> "Drying ovens have received much attention and continuous registration of temperatures on recording thermometers is the rule in many American foundries."

THIS is but another of the many measures which are being taken throughout the world to limit the variables in foundry practice. Accurate knowledge of the factors contributing to satisfactory core work is essential to the production of high quality castings in any class of work.

¶ Foundry Index Ready

AN INDEX of all articles appearing in THE FOUNDRY during the year 1926 has been prepared for distribution. The index gives complete references and cross references of articles in the entire 24 issues. Readers who bind or preserve the past issues of this publication will find the index of considerable value. It will be mailed free to any reader who requests it from THE FOUNDRY, circulation department, Penton building, Cleveland.

CARE OF GLUE IN THE PATTERN SHOP

Glue is animal matter and as such is influenced by atmospheric changes. If stored in a warm place it will dry out gradually and undergo certain chemical changes, which cause it to deteriorate and ultimately become useless. Similarly, if glue be subjected to undue dampness, the same results will be brought about. To insure the best results care must be taken to store it in a cool, dry place.

Barrels should not be left open for dust to accumulate and contaminate the glue; if exposed to dust and to dampness at the same time, the surface of the glue becomes softened and the dust, carrying with it countless bacteria, at once promotes the decomposition of the glue. Wherever feasible, the barrels should be reheaded after withdrawing portions for use or provided with a well-fitting, dust-proof cover, removable at will.

None but cold water should be used for soaking glue and this furthermore must be clean. It is equally essential that the water be soft; that is, contain not more than a trace of such chemical substances as lime, magnesia or iron. There are chemical elements in the majority of glues which, when the glue is melted, will combine with the lime, magnesia or iron, so that much of the true glue is destroyed. Soft water is not always available and the use of distilled water is apt to be expensive.

Water Softening

The following simple treatment will render the water sufficiently soft for use with any glue, however, delicate. A tank containing a day's supply of water may be erected at small cost and may consist of the ordinary wooden vat. For every 1000 gallons of water contained in this tank, introduce one-half pound of ordinary washing soda. By means of a steam coil at the bottom of the tank, the soda may be dissolved with a gentle current of steam and this circulated through the water, which may be permitted to become lukewarm. In about four hours' time the hardening salts will have been precipitated from the water and settle

Abstracted from the serial report of the power committee of the National Electric Light association, New York.

(*Continued on Data Sheet No.* 654)

CARE OF GLUE IN THE PATTERN SHOP

(*Continued from Data Sheet No.* 653)

to the bottom of the tank, which must be cleaned at judicious intervals. The water supply may be drawn by means of a floating syphon from the top. Too much stress cannot be laid upon adequately softened water for dissolving glue. Many a good glue has been condemned because the water employed for its soaking was too hard.

The importance of preparing the glue solution by accurate weight, *not measure*, of water and glue, that is a definite proportion of each, cannot be emphasized too strongly. This proportion of glue to water depends on the quality of glue being used—the stronger the glue the higher its water absorbing properties. The requirement for which it is to be used must also be given due consideration. Mixing glue according to dry measure, that is, by the use of scoops, buckets, etc., is not accurate and inevitably will bring on trouble sooner or later. A uniform glue used according to a uniform method always will give dependable results.

The room for soaking the glue should be cool for the reasons outlined with reference to cool storage.

No definite period for soaking the glue can be prescribed, as this will depend upon the form of the glue. If in the flake form much will depend upon the thickness. Ground glue, depending upon the mesh, can be soaked and ready for melting in thirty minutes to one hour. Thick flake glue, as for instance imported glue, may require 24 hours' soaking. Ordinary domestic flake, if thin, will be ready to melt in two hours. If medium, in four hours. If thick, in six or eight hours; and if extra thick, in from ten to 12 hours. You may judge of the degree of soaking by removing a piece from the water, which, when squeezed between the thumb and finger, should yield, permitting the fingers to meet. In such case the glue has been adequately soaked.

Ground glue may be soaked quickly, provided the operator be careful in wetting it in the first place. The measured quantity of glue should be placed in the soaking vessel, and the water added *little by little with* constant and thorough stirring. In this way each tiny particle of the glue is thoroughly wet down and will take up the required water with marked rapidity.

(*Continued on Data Sheet No.* 655)

THE FOUNDRY DATA SHEET, JAN. 15, 1927

Payment will be made for all contributions on foundry and pattern shop practice suitable for publication

Note—This sheet may be cut into two sections, 5 x 7 inches and may be readily bound in notebook form

Seeing America with The Foundry

Little Journeys to the homes of our readers

Hopi Indian

ARIZONA has a total of 9 Foundries of which
9 Melt Gray Iron.
9 Nonferrous Depts. of other foundries.
1 Melts Malleable Iron.
1 Melts Steel.
1 Melts Aluminum.

ARIZONA, the forty-eighth state in the American Union, the last territory in continental United States to be admitted to statehood, is rich in minerals and for many years has been the seat of mining occupations. The copper industry is by far the largest and this state ranks first in the production of this metal being approached only by Montana. Gold, silver, lead, zinc and copper add over $100,000,000 to the wealth of this state every year.

In the northwestern part of the state is the Grand Canyon of the Colorado River, one of the natural wonders of the world; it is approximately six miles wide at the top and 6,000 feet deep. In the northern part of the state is the Painted Desert and the petrified forest. The Roosevelt Dam, constructed by the government and completed in 1911, impounds water sufficient to irrigate more than 2,000,000 acres which can be irrigated with profit.

In ARIZONA—THE FOUNDRY has 7 paid subscribers.

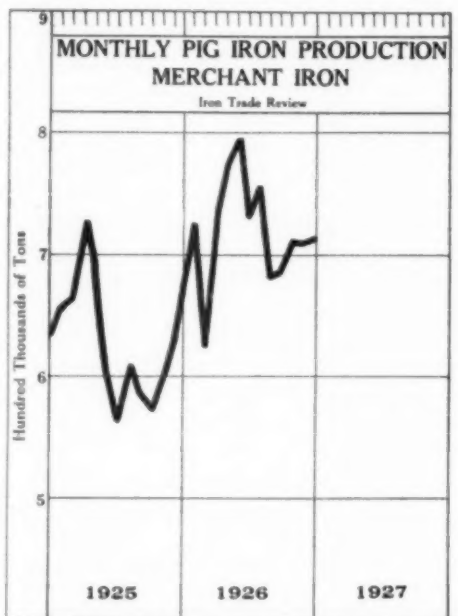
"Wherever metals are cast you'll find THE FOUNDRY"

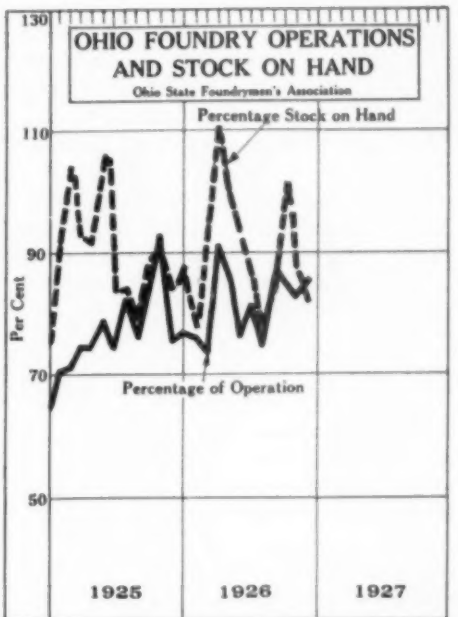
Trade Trends in Tabloid

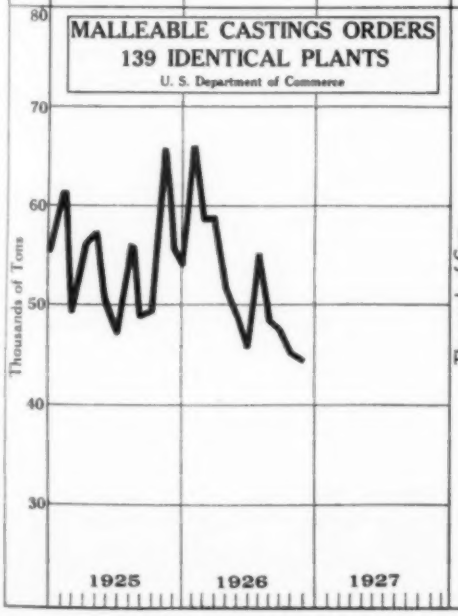
MEASURED on the scale of actual operations, the foundry activity of early January is spotty. General jobbing demand follows closely the fortunes of consumer activity. Shops making heavy machinery castings for the steel industry are fairly busy. Automotive foundries are beginning to get under way on 1927 requirements which promise well for the late winter and early spring. Railway car demand is picking up backed by December awards in excess of 10,000 cars and with inquiries for about 15,000 additional carried over into 1927. Blast furnace activity declined slightly in December, according to statistics compiled by *Iron Trade Review*. The iron output for the past month was 3,094,629 tons compared with 3,237,992 tons for November. Merchant iron output for December was slightly higher, reaching 716,127 tons in December compared with 710,362 tons in November. Seven blast furnaces making merchant iron were blown out and two put in service during December. Average daily prices for nonferrous metals, from New York quotations in the *Daily Metal Trade*, follow: Casting copper, 13.171c; electrolytic copper, 13.557c; Straits tin, 68.482c; lead, 7.856c; antimony, 13.870c; aluminum, foundry ingot, 26.73c and Zinc averaged 7.023c, E. St. Louis, Ill. Brass foundry activities are slightly lower, but business is expected from automotive plants.

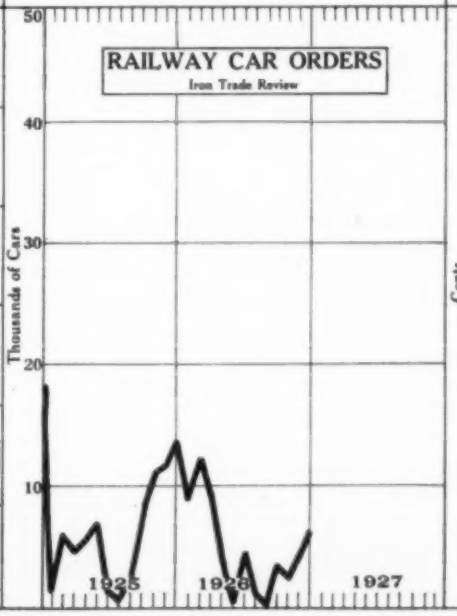
RAW MATERIAL PRICES
Iron
Jan. 7, 1927

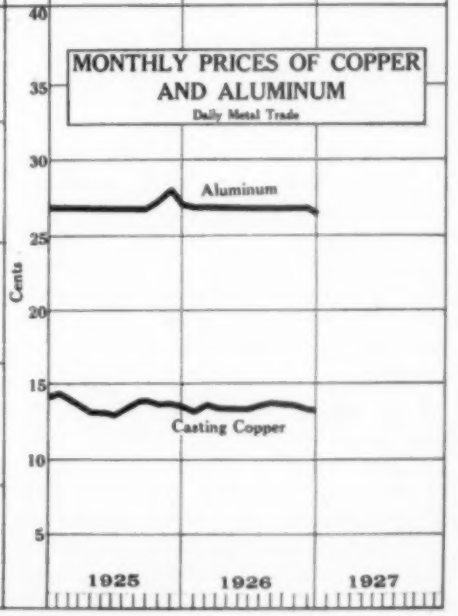
No. 2 foundry, Valley	$18.50 to 19.00
No. 2 southern Birmingham	20.00
No. 2 foundry, Chicago	21.00
No. 2 foundry, Philadelphia	22.76
No. 2 foundry, Buffalo	20.00
Basic, Valley	18.50
Basic, Buffalo	19.00
Malleable, Chicago	21.00
Malleable, Buffalo	19.00 to 20.00
Coke	
Connellsville foundry coke	$4.50 to 5.00
Wise county foundry coke	6.00
Scrap	
Heavy melting steel, Valley	$16.50
Heavy melting steel, Pitts.	16.75 to 17.25
Heavy melting steel, Chicago	13.00 to 13.50
Stove plate, Chicago	14.00 to 14.50
No. 1 cast, New York	14.50 to 15.00
No. 1 cast, Chicago	16.50 to 17.00
No. 1 cast, Philadelphia	17.00 to 18.00
No. 1 cast, Pittsburgh	16.00 to 16.50
No. 1 cast, Birmingham	16.00 to 17.00
No. 1 cast, Buffalo	15.00 to 15.50
Car wheels, iron, Pittsburgh	16.00 to 16.50
Car wheels, iron, Chicago	14.75 to 15.25
Railroad malleable, Chicago	16.00 to 16.50
Agricultural, mal., Chicago	15.25 to 15.75
Malleable, Buffalo	17.00 to 17.50
Railroad malleable, Pitts.	17.00 to 17.50
Nonferrous Metals	Cents per pound
Casting copper, refinery	12.62½
Electro copper, producers	13.12½ to 13.17½
Straits tin	67.00
Lead, New York	7.65
Antimony, New York	13.37½
Nickel, electro	39.00
Aluminum, No. 12, prod'rs	25.50
Aluminum, No. 12 remelt	21.50 to 22.00
Zinc, E. St. Louis, Ill.	6.90 to 6.92½











Personal

J. R. Thompson, formerly acting works manager of the Trafford Works of the Westinghouse Electric & Mfg. Co., Trafford City, Pa., has been promoted to works manager of the same plant. His connection with the company began in 1897 when he was employed with the Westinghouse Machine Co. as a time clerk. Later in the year he was made paymaster. In 1901 he served as assistant purchasing agent and then went into the accounting department. Mr. Thompson became associated with the Trafford works in 1904 and was made assistant to the manager in 1908. He has held the position of acting works manager since Oct. 1925.

Clyde H. Burgston has been promoted to assistant superintendent of the Union Malleable Iron Works, East Moline, Ill.

W. J. Stoop, general engineer of the Wheeling Corp., Wheeling, W. Va., has been made general manager of the Morgan Engineering Co., Alliance, O.

George M. Blakewell, formerly overseas representative of the Champion Spark Plug Co., Toledo, O., has been made head of the export department of the Bunting Brass & Bronze Co., Toledo, O.

Joseph P. Wright, who has been connected with the National Malleable & Steel Castings Co., Cleveland, for a number of years, has become associated with Samuel Ungerleider & Co., New York.

William Krug is now coreroom superintendent with the Gurney Heater Mfg. Co., Framingham, Mass. Mr. Krug has had 33 years' experience in foundries and pattern shops and has held the position of foundry foreman in various shops throughout the country.

W. S. Koithan and R. W. Proyer Jr., for many years joint managers of the New York office of the Buffalo Forge Co., and the Buffalo Steam Pump Co., Buffalo, have been placed in charge of the Philadelphia office of those companies. They will continue to manage the New York district.

Professor Thomas Turner's retirement from the chair of metallurgy in the University of Birmingham, Eng., on Dec. 3, 1926 was marked by a presentation of gifts from numerous past and present students, colleagues and friends. He received a framed photograph of himself which will hang permanently in the metallurgical department of the university. In addition a bound volume containing the names of the subscribers and an expression of appreciation of his services to metallurgy, and an automobile were presented. Professor Turner has been awarded the Bessemer gold medal of the Iron and Steel institute. By his original researches he has enriched the science of metallurgy and has exerted an influence upon the development of metallurgical technique which place him in the fore front with great metallurgists of his generation to whose genius the advances of the last few decades are due.

C. W. COLEMAN

Engages in Business

C. W. Coleman who recently severed his connection with the Tabor Mfg. Co., Philadelphia after 31 years' service in selling and demonstrating that firm's molding machines in America and Europe, has engaged in business on his own behalf at 10 Savoy street London, Eng. He will handle various types of foundry equipment and also will represent the Pangborn Co., Hagerstown, Md. Mr. Coleman learned his trade as molder in 1893 in Rhode Island and through his skill in obtaining high production from molding machines, he was engaged by the Tabor company as a demonstrator. In 1896 he installed the first American molding machine taken to England at the works of Alfred Herbert, Coventry. He remained in England until August 1905 when he returned to represent the Tabor Co. in New England states and Canada. Later Mr. Coleman removed his headquarters to Chicago. In 1912 he again was sent to Europe and has remained there since. During this long term of service he has represented the Tabor company in Great Britain and Ireland, France, Belgium, Germany, Holland, Switzerland, Italy and America.

Colleague Is Honored

On Dec. 15, 1926, the council of the French Foundry high school joined with the professors and graduates of the school in holding a banquet and reception to honor E. V. Ronceray, recipient of the J. H. Whiting gold medal which was conferred upon him at the International Foundrymen's congress in Detroit. At the end of the dinner, Mr. Rivoire, one of the first foundry engineers to graduate from the school, emphasized the part that Mr. Ronceray had and still is taking in educating foundrymen in France. Mr. Ronceray's efforts resulted in the creation of the school of foundry in Paris, and he continues to give up part of his time to improving the courses and the organization of the school. In the name of his colleagues the speaker expressed his gratification at the important gesture of the American foundrymen and as a memento of this event he presented Mr. Ronceray with a handsome work of art.

Ch. Dufour, president of the Syndicat General des Fondeours de France and of the council of the school of foundry, also spoke and congratulated Mr. Ronceray on his having been honored by his American colleagues. Responding, Mr. Ronceray expressed his appreciation at receiving such a valuable token of esteem from the American Foundrymen's association, also his gratitude for the sentiments shown by his French foundry friends and associates.

British Hear Talk

At a meeting of the Birmingham, Coventry and West Midlands branch of the Institute of British Foundrymen held at Birmingham, England, on Dec. 14, W. West, Leyland Motors Ltd., described a method of making motor cylinders entirely in oil sand cores. The method of molding and assembling the cores was illustrated by a moving picture film. Mr. West and William Aston who was associated with him in the work, claimed that oil sand used in facing or for molds, produced castings of greater accuracy from the patterns. Use of molasses was commended though it

weakened beyond a certain limit. Addition of dextrine or core gum tended to make the emulsion permanent. However, a quick drying oil is necessary. Heating of linseed oil is beneficial and better cores are obtained in a quicker time by baking at 250 degrees Cent. Addition of rosin increased the green sand strength of the cores. West and Aston claimed that in the manufacture of cylinders using oil sand they obtained 97.5 per cent of good castings.

To Hear Address on Coke

Members of the Pittsburgh Foundrymen's association will hear an illustrated talk by F. B. Miller, sales manager, Keystone Coal & Coke Co., on "Coke-What It Is and How It Is Made." The meeting will be held at the Fort Pitt hotel Jan. 17. A group discussion on foundry foremen training under the direction of the Pennsylvania State college also will be held.

Record Is Celebrated

A safety first entertainment and dance was held on Dec. 16 by the Arthur Foundry, Utah Copper Co., Garfield, Utah, to observe the record of foundry operation for 12 months without an accident under direction of T. F. Jennings. Speeches were made by O. F. McShane, chairman, Utah Industrial commission; Roy Hatch, superintendent, Arthur plant; E. W. Engleman, superintendent, Magna plant; F. O. Raymond, superintendent, B. &. G. railroad, and R. G. Lucas, industrial representative, Utah Copper Co. T. F. Jennings, superintendent of the foundry, was chairman, and M. A. Moffet vice chairman of the committees.

Paris Offices Enlarged

OFFICES of THE FOUNDRY *in Paris have been removed to larger quarters at 9 Rue de Londres where this publication will be represented hereafter by L. Jaudoin. Mr. Jaudoin, who is a graduate of the Ecole des Mines of Paris, has had an extensive industrial experiecne in Western Europe which especially qualifies him to represent this publication. The Paris office will continue to be operated under the direction of Vincent Delport, European manager, Caxton House, London, S. W. 1.*

The new Paris quarters, in the center of the city are in the neighborhood of the main offices of several of the largest engineering and industrial concerns in Paris and within easy access of the principal business and shopping sections and the stations of the three northern railroads.

Visitors always are welcome at the Paris offices of THE FOUNDRY *where a complete file of Penton publications will be found, with cablegrams from America giving the latest industrial news from home. The telephone number of the new Paris office is Central 95-10.*

Elected Vice President

S. H. Cleland, formerly president of the Interstate Specialties Inc., New York, has severed his connection with that firm and recently has been elected vice president of the Eastern Clay Products Co. Inc., Rochester, N. Y.

Sculptor Is Foundryman

Jerome Connor, Washington sculptor, whose statues and war memorial works may be seen in many cities, has established the first bronze statuary foundry in Ireland. The foundry which is at Dublin, already has been placed in operation. Mr. Connor says he will make his permanent home in Ireland and that he intends to become a foundryman.

H. T. Taylor, 186 Florence avenue, Detroit, has been appointed district representative by the Shanafelt Mfg. Co., Canton, O.

Foundry Association Directory

American Foundrymen's Association

President, S. W. Utley, Detroit Steel Casting Co., Detroit; secretary-treasurer, C. E. Hoyt, 140 South Dearborn street, Chicago; technical secretary, R. E. Kennedy, 909 W. California street, Urbana, Ill.

The Buffalo Foundrymen
Buffalo

President, J. McARTHUR, Washington Iron Works; secretary, W. J. WARK, E. J. Woodison Co., 146 Chandler street. Meetings the third Wednesday of the month at 146 Chandler street.

Chicago Foundrymen's Club
Chicago

President, CHARLES L. LARSEN, Armour Institute of Technology, 3200 Federal street, Chicago; secretary, ROGERS A. FISKE, 10 S. LaSalle street, Chicago. Meetings second Saturday in each month at the City club, 315 Plymouth court.

Connecticut Foundrymen's Association

President, FRED W. STICKLE, Capitol Foundry Co., Hartford, Conn.; secretary, C. S. NEUMANN, Union Mfg. Co., New Britain, Conn. Meetings are on second Friday of each month in various parts of the state.

Detroit Foundrymen's Association
Detroit

President, ROBERT G. CRAWFORD, Atlas Foundry Co., 131 South Artillery street, Detroit; secretary, RUSSELL M. SCOTT, Packard Motor Co., 1580 East Grand boulevard, Detroit. Meetings third Thursday in each month at the Union League club, 35 Grand River avenue, Detroit.

Metropolitan Brass Foundry Association
New York

President, THOMAS HARPER, Thomas Harper, 204 Lafayette street, New York; secretary WM. E. PAULSON, Thomas Paulson & Son Inc., 97 Second avenue, Brooklyn, N. Y. Meetings second Wednesday in each month at the Building Trades club, 34 West Thirty-third street, New York.

Newark Foundrymen's Association
Newark, N. J.

President, J. L. CARTER, Barlow Foundry, Inc., Newark; secretary, W. H. MANTZ, Atlas Foundry Co., Irvington, N. J. Meeting called by president.

New England Foundrymen's Association

President, H. P. BLUMENAUER, Arcade Malleable Iron Co., Worcester, Mass.; Secretary, FRED F. STOCKWELL, 205 Broadway, Cambridgeport, Mass. Meetings second Wednesday of each month at the Exchange club, Boston. Outings usually are held in the summer months.

Ohio State Foundrymen's Association

President, WALTER L. SEELBACH, Walworth Run Foundry Co., 2488 West Twenty-seventh street, Cleveland; secretary-manager, ARTHUR J. TUSCANY, 5713 Euclid avenue, Cleveland.

Philadelphia Foundrymen's Association
Philadelphia

President, WALTER WOOD, R. D. Wood & Co., Philadelphia; secretary HOWARD EVANS, J. W. Paxson Co., Luzerne and D streets, Philadelphia. Meetings the second Wednesday of each month at the Manufacturers' club.

Pittsburgh Foundrymen's Association
Pittsburgh

President, LAWRENCE V. STEVENS, Locomotive Stoker Co., N. E. Pittsburgh; secretary-treasurer, WM. J. BRANT, Wm. J. Brant, Bessemer building, Pittsburgh. Meeting on the third Monday of the month, except in July and August, at Fort Pitt hotel.

Quad-City Foundrymen's Association
Davenport, Iowa

President, J. H. DIEDRICH, Blackhawk Foundry & Machine Co., Davenport, Iowa; secretary-treasurer, A. D. ZIEBARTH, Davenport Foundry & Machine Co., Davenport, Iowa. Meetings the third Monday evening of each month, the meeting place being rotated between Moline, Rock Island and Davenport.

Southern Metal Trades Association
Atlanta, Ga.

President, GEORGE B. COCKER, Gastonia, N. C.; secretary-treasurer, W. E. DUNN Jr., Healey building, Atlanta, Ga.

Tri-City Technical Council
Moline, Ill.

Chairman, H. BORNSTEIN, Deere & Co., Moline, Ill.; treasurer, MAX SKLOVSKY, Deere & Co., Moline, Ill. Combined meetings held only one or two times a year on call.

Tri-State Foundrymen's Association
Cincinnati

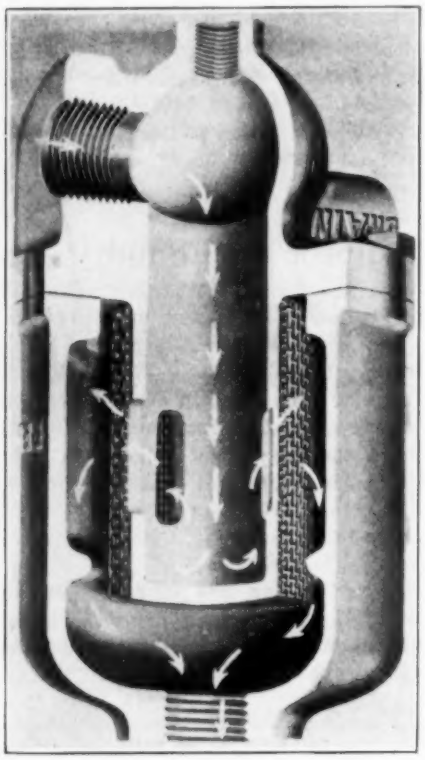
President, HAROLD P. RITTER, John A. Oberhelman Foundry Co., 3323 Colerain avenue; secretary, GEORGE W. PIEHL, Wessling Bros. Foundry Co., 1607 McLean avenue. Meetings the second Thursday of each month at the Cincinnati club, Eighth and Race streets.

Twin City Foundrymen's Association
Minneapolis-St. Paul

President, J. A. TEACH, Minneapolis Steel & Machinery Co., Minneapolis; secretary-treasurer, C. E. LANGDON, 3849 Lyndale avenue, So., Minneapolis. Meetings monthly at the Athletic club.

Separates Moisture from Compressed Air

A separator of simple construction which removes oil and moisture from compressed air, recently has been placed on the market by the Smith-Monroe Co., 223 South Main street, South Bend, Ind. Compressed air carrying oil and moisture enters the separator through the horizontal inlet, shown by arrows in the accompanying illustration. The air travels upward to the top of the inner chamber where it is deflected downward and out horizontally through the slotted openings into the outer chamber. Many thicknesses of coarse brass screen surround the inner chamber, and serve to impede the flow of air through the opening, forcing it to follow a zigzag course through the screen to reach the outer chamber. This rapid change in direction in the short distance which the air travels, causes the moisture and oil to be carried beyond the air and deposited on the strands of screen. The moisture then falls into the dead air space at the bottom of the chamber.



THE PLANER MAY BE MOUNTED ON THE BENCH OR THE BASE SHOWN

Before the air leaves the outer chamber, it must pass around a projection cast in the upper part of the chamber. This chamber prevents any capillary action and maintains the air in the upper chamber free from moisture. The oil and water, which collect in the ring at the bottom of the chamber, drain off through a drop pipe in the shut-off valve. The operation may be made automatic by the use of a special trap which discharges the collected oil and water. The separators are made for either a ¾ or 1-inch line.

Planer Is Applicable to Patternshops

A hand planer and jointer, which may be used on the bench or with a special base, recently has been placed on the market by the Oliver Machinery Co., Grand Rapids, Michigan. The tables, which are shown in the illustration at the right are of cast iron with removable steel lip at the cutting throat. Each table is 6½ inches wide while the front or operating table is 24½ inches long and the back table 15½ inches long. Both tables have dovetailed inclined ways which are hand scraped. Each table is adjustable independently toward and away from the cylinder by a knurled hand wheel and steel screw. The tables also are adjustable for rabbeting up to ½-inch deep with two locking screws for each table.

The cylinder is furnished with either two or three knives as specified. The cylinder has a 3⅛-inch cutting diameter. The recommended speed for the three-knife cylinder is 3600 revolutions per minute and for the two-knife cylinder 4500 revolutions per minute. The machine is equipped with an automatic guard. The guard swings on a stud fastened under the rear table and has a spring and adjustable rubber tipped bumper for the return.

The machine may be driven with a motor connected direct to the cylinder shaft, by a direct coupled motor and by a belted motor. The motor should be from ½ to 1 horsepower, depending on the kind of work.

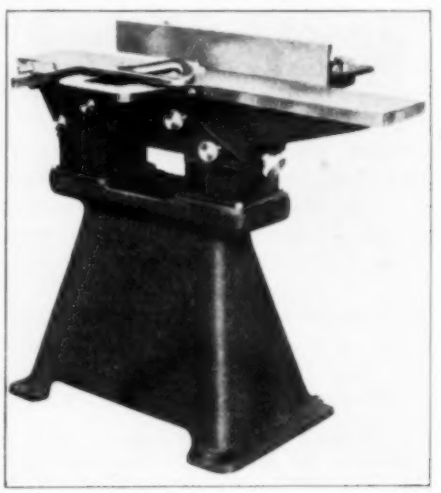
Book Review

Aluminum and Its Alloys, by M. G. Corson, 291 pages, cloth 6 x 9 inches, published by D. Van Nostrand Co., New York, and supplied by THE FOUNDRY, Cleveland for $8, and in London, 2-3 Caxton House, Westminster, S.W.1, for 40s.

Pure aluminum and its properties compose the introduction to the book which is divided into 6 sections or parts. Part II contains a systematic description of the binary aluminum alloys series and includes 44 elements alloyed with aluminum beginning with silver and ending with zinc. The ternary systems of aluminum alloys also are included in this section. Technology of aluminum alloys constitutes part III and includes a historical review, the light alloys, casting alloys, foundry methods, duralumin, and alloys for high temperature work. Part IV is devoted to corrosion; part V to aluminum alloys in engineering work and part VI to the structure of aluminum alloys. Numerous diagrams and tables contained in this volume will be found useful to the metallurgist and to the foundryman who work with aluminum and its alloys. One hundred and twenty-two inserted plates show the micrographic and macroscopic structure of the various alloys.

Defective Mold Cause of Hole in Casting

Question: We are forwarding you a 9½-inch diameter solid gear blank with a defect 1-inch in diameter and nearly 1-inch deep on the cope side. Several of our castings are rejected from the same general cause. In some of them two or three cavities appear while in others the depressions vary from ¼-inch to 3 inches in diameter and ¼-inch deep. We have had considerable discussion over the probable cause of this trouble and will appreciate your opinion.



THE MOISTURE IS DEPOSITED ON THE COARSE BRASS SCREEN

Answer: The smooth surface on the cavity indicates that it was filled with steam, smoke or gas and a brief observation of a few molds during the molding and pouring process should indicate which is responsible. You can satisfy yourself of the condition of the mold by placing a large riser on the copes of a few and watching the action of the metal as it fills the mold. Instead of rising quietly it will boil and bubble to a considerable extent. The cause may be any one or combination of several factors and the solution of the prob-

lem merely is a process of elimination. The first and most probable cause is that the steam is given no opportunity to escape from the sand in the drag. In addition to the large volume of steam generated under the casting, the ring core which forms the hub, throws off a considerable quantity of gas which also has to pass through the sand in the drag. It the sand is rammed hard, if it is too damp, if it is *close* enough to require venting with a wire and then remains unvented, most of the steam and gas will boil up through the iron and while some of it will escape through the cope, through a riser (if one is provided) or through the gate, a sufficient quantity will remain trapped in the metal against the face of the cope to form the defects to which you refer. There is a possibility that your sand and ramming methods are quite correct, but the bottom boards on the flasks are jammed on so tightly that the steam has no chance to escape. Either use perforated bottom plates under the drags or provide a bed of sand between the drag and the plate.

Changes Connection

S. L. Dryfoos, formerly general manager of the Taylor & Boggis Foundry division, Consolidated Iron-Steel Co., Cleveland, has resigned after 16 years' association with that organization to become associated with the Foundry Equipment Co., Cleveland, as vice president. Mr. Dryfoos was graduated from the Case School of Applied Science in 1906 and has been in blast furnace work. Later he was in the sales department of an eastern steel company prior to his association with the Taylor & Boggis foundry.

Investigates Properties

In an investigation of the physical properties of some nickel-iron alloys of the invar group, Eric. A. Blomqvist, Rensselaer Polytechnic institute, Troy, N. Y., found that these alloys needed manganese additions to make them forgeable even though magnesium was added to remove any sulphur. Effects of nickel and of manganese indicated by earlier workers were confirmed. Additions of either or both increase the coefficient of expansion. Annealing causes a decrease in length while quenching produces an increase. Annealing also raises the coefficient of expansion and quenching lowers it. Details on the methods used, results and the compositions of the alloys may be found in engineering and science series No. 13 published by the Renssalaer institute.

Obituary

R. A. Browne, secretary and treasurer of the Riverside Iron Co., Chicago, died recently at his home in that city.

Frank M. Bookwalter, 79 years old, banker and manufacturer of turbine water wheels, Springfield, O., died recently at his winter home in Bay Haven, Fla. He was vice president and treasurer of James Leffel & Co.

Edward L. Reinhard, American Radiator Co., Buffalo, died Dec. 20, 1926 at his home in that city, aged 47 years. He was born in Columbus, O., Oct. 7, 1879 and joined the American Radiator Co., about 15 years ago.

Harry P. Otis, former president of the Norwood Engineering Co., Florence, Mass., and treasurer and general manager of the Northampton Emery Wheel Co., Northampton, Mass., died Dec. 26, 1926 at his home in Florence, Mass., aged 73 years. He was born in Manchester, Conn., and was graduated from the engineering department of the Massachusetts Agricultural college in 1875.

George R. Matheson Jr., vice president, treasurer and director of the Spang-Chalfant Co., Etna, Pa., died Dec. 30 after a month's illness. He also was president and a director in the First National Bank of Etna, and a director of the Mackintosh-Hemphill Co., Pittsburgh.

Mr. Matheson was born in Etna, Pa., April 8, 1876. Early in life he was connected with his father and grandfather, George Matheson, a pioneer in the local pipe industry, in the management and operation of the American Tube & Iron Co., Middletown, Pa. Later he represented this firm in Youngstown, O., until it was sold to the United States Steel Corp., when he obtained a position in New York with the United States Steel Products Co. He remained there until 1905, when he became chief clerk of the Spang-Chalfant Co., successively rising to vice president and treasurer.

Publishes Bibliography

Metallurgists and others interested in stainless steels will find extremely useful a new bulletin published by the department of engineering research, University of Michigan, Ann Arbor, Mich. The title of the bulletin is "Stainless Steel, A Digest with Abstracts and Bibliography." It was written by A. E. White and C. L. Clark. Engineering research bulletin No. 4 is arranged in four parts and contains a brief sketch of the facts regarding stainless steels; abstracts of important articles on the subject; a bibliography and a number of graphical studies. The price of the bulletin is 50 cents.

Meeting Is Announced

The spring meeting of the American Electrochemical society will be held at the Benjamin Franklin hotel, Philadelphia, from April 28 to 30. This meeting will mark the twenty-fifth anniversary of the society's organization. Elaborate plans are being made for the celebration.

Capital Is Increased

Black & Decker Mfg. Co., Towson, Md., manufacturer of portable electric tools, has issued $1,250,000 of 10-year, 6½ per cent, sinking fund, convertible debentures, the proceeds from which will be used to provide additional working capital for the company.

Inaugurates New Plan

Until recently the various foreman training courses of the extension department, Pennsylvania State college, State College, Pa., have been administered through the correspondence and lecture methods, and combinations of both. Now this service is carried on by the conference method under the direction of R. M. Holmes, formerly with the American Steel Foundries, Chicago. A chairman or conference leader is appointed for each group, but he is not a teacher. His duty is to employ questions to develop free discussion among the members and keep the discussions from digressing. By the conference method it is claimed the foremen teach themselves.

Recommends Chills for Blank Gear Face

By T. W. Smith

An answer to a correspondent in a recent issue of THE FOUNDRY on the subject of shrinkage in gear wheel blanks 3 feet in diameter reminds me that I have seen hundreds of similar wheels made and machined without showing a trace of shrinkage. They were poured from the regular iron used in a pipe shop to pour spe-

cial shapes in green sand. The outside of the wheel was cast against a chill either in one piece or in sections. The face of the chill was not machined. The chills were 2 or 3 inches thick and the large ones were provided with eye bolts for convenience in handling. They were kept dry and warm and were blacked on the face before they were placed in the molds. Patterns for these wheels purposely were left rough on the outside to remind the molder that they were to be enclosed in chills before the sand was rammed around them. As an additional reminder the word *chilled* was either stamped on the face or formed with raised letters set in a recess. Molds made with chills are provided with ample gates and the iron is poured rapidly to prevent cold shuts on the face. Usually about ¼-inch is allowed on the face of the casting for machining and this will clear out many waves and incipient cold shuts that may appear on the surface.

One Fan Supplies Blast for Two Cupolas

Question: I have some 6½-ton castings to make and I want to operate my two cupolas, one lined to 42 inches and the other lined to 24 inches. Both are piped to a No. 8 fan made by the B. F. Sturtevant Co. and I am wondering if this fan running at 1800 revolutions will supply sufficient air for the two cupolas. I shall appreciate your advice on the proper weight of iron and coke charges to use in these cupolas where the top of the tuyeres in both cases is 17 inches above the sand bottom.

Answer: Unless you want to pour some of the smaller work while the large ladle is filling, we see no reason for operating both cupolas. A 42-inch cupola has a melting capacity of approximately 7 tons per hour. According to information published by the B. F. Sturtevant Co., a No. 8 fan running at 2270 revolutions supplies sufficient air for a 60-inch cupola. On that basis it should easily supply both a 42-inch and a 24-inch cupola at the same time.

The usual charge for a 42-inch cupola is 2000 pounds of iron and 200 pounds of coke. For a 24-inch diameter cupola the charge is 500 pounds of iron and 50 pounds of coke. Where exceedingly hot iron is required, or where the coke is not of a superior quality, the amount of coke is increased. We are not familiar with the coke supplied in your district and therefore cannot indicate the proper weight of coke for the bed. You can determine the amount more satisfactorily by measurement. The bed coke after it has burned through and settled down should extend between 24 and 30 inches above the top of the tuyeres.

Better Gating Reduces Losses on Bases

By Donald A. Hampson

Changing the style of gate from

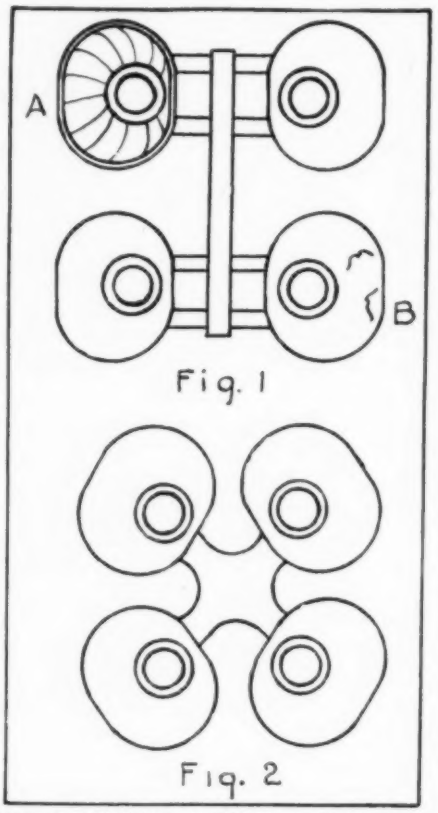


FIG. 1—ORIGINAL STYLE OF GATE. FIG. 2—THE PATTERNS WERE GROUPED CLOSE TO A SHORT DIRECT GATE

that shown in Fig. 1 to that in Fig. 2 in the accompanying illustration cut out the wasters on a radio base contract. The casting is an oval shaped base 6 inches on the long diameter, 3/16-inch thick at the rim and with a rise of about an inch to a round pocket in which the upright member of the device is fastened later. The weight is a little less than 3 pounds.

The customer supplied the four aluminum patterns gated as shown in Fig. 1. The upper surface of the base, *A* Fig. 1, has a series of flutes extending from the hub toward the rim. A lacquer finish later is applied to the casting. If any surface imperfections show through, the casting is rejected.

Although the iron was poured hot, cold shuts appeared in at least one casting out of every group of four as shown at *B* Fig. 1. In many cases the molds did not fill out completely.

The method of gating was changed to that shown in Fig. 2 where the four patterns are nested close together. This arrangement permitted the use of a Greek cross form of gate with a short distance for the iron to run to reach each unit in the mold. A marked improvement was noted at once and after a little further adjustment a most satisfactory production was secured.

Book Review

Industrial Furnaces, Vol. II; by W. Trinks; cloth, 405 pages, 6 x 9 inches; published by John Wiley & Sons Inc., London and supplied through THE FOUNDRY at $5.00 net and in Europe by Penton Publishing Co. Ltd., Caxton House, London, at 1 pound 5 shillings net.

While this volume is a continuation of the first, it is complete in itself. The first volume contains much theory and appeals largely to the designer of furnaces, the second is devoted principally to practice and appeals more largely to co-ordinators of existing designs.

Much equipment is described in this volume, fundamental types being selected by preference. Some of this is patented and use of devices described in the book, the author warns, may be infringement unless its status is investigated.

Because of the wide field covered the author has been compelled to avail himself of the experience of others and the volume is to some degree a composite of the thought of this branch of industry.

Fuels and sources of heat energy treated in the first chapter, and combustion devices and heating elements follow. Control of furnace temperature and atmosphere and labor saving appliances then are treated and the author essays a critical comparison of fuels and furnace types to aid in choice of the proper form of furnace. In the final chapter selection of fuel and furnace to suit plant conditions is outlined.

Iron Lost in Melting

Question: What percentage of iron is lost in the cupola during the melting process?

Answer: The amount of iron lost each time it is remelted depends on various conditions, among which may be mentioned the blast pressure and the character of the iron itself. More iron is lost with a heavy blast than with a blast that is mild and gentle. The loss is heavier where light scrap is used. For all practical purposes it has been found that an allowance of 3 per cent for pig iron, 5 per cent for medium and 10 per cent for light scrap will figure out just right.

Market Improving Gradually

Sales Increase as Holiday and Inventory Period Ends— Many Live Inquiries Current—November Sales Gain

BUSINESS in the foundry equipment market gradually is recovering from the slack period experienced during the last two weeks of December. Most foundries have completed their inventories and now are preparing to secure any equipment that may be needed. In the Cleveland territory, sales have increased and inquiries again are being brought out.

Sales of foundry equipment in Pittsburgh and vicinity since the first of the year have been only fair although a large number of propositions still are pending. The list includes a number of inquiries for sand equipment of various types. Considerable molding machine business is pending and at least two core oven inquiries are up.

In the Chicago territory, December sales closed below the total for November, but exceeded that for December, 1925. The new year opened satisfactorily with sellers predicting that greater sales effort will be necessary in 1927. A large number of inquiries are current.

With the inventory season at an end, foundry equipment sellers in the eastern district are looking toward an early improvement in demand. Inquiries are in slightly better volume and a healthy condition prevails throughout the metal working industries generally. Plant construction programs as yet have not had an opportunity to develop, but increased car buying is expected to be reflected in equipment sales.

Foundry equipment sales in New England suffered severely during the holiday season and the recovery not yet is in sight. Several molding machines have been placed in foundries in Massachusetts and Connecticut, but no large sales are noted.

Sales of foundry equipment in November showed a gain of 15 per cent compared with October and a loss of 24 per cent over November, 1925, according to a report of the Foundry Equipment Manufacturers' association. The value of sales in November was $454,536 as compared with $396,354 in October and $595,739 in November of last year. Shipments lost 9 per cent over October and 19 per cent over November a year ago. The value of shipments in November was $405,345 as compared with $447,189 in October and $503,093 in November, 1925. Unfilled orders gained 8 per cent on Dec. 1 over Nov. 1, the value for Dec. 1 being $507,608 compared with $524,612 on Nov. 1. Sales for the first 11 months of the year gained 9 per cent over the total for the corresponding period a year ago.

CHICAGO MARKET

Cranes

Union Malleable Iron Co., East Moline, Ill., one 5-ton crane from the Whiting Corp., Harvey Ill.

Molding Machines

Washington Foundry Co., St. Paul, tractor type sand throwing machine; Mathews Steel Castings, Inc., Chicago, stationary type sand throwing machine with turntable and auxiliary equipment; Kewanee Boiler Co., Kewanee, Ill., portable type sand throwing machine from the Beardsley & Piper Co., Chicago.

Sand Preparing Equipment

Semi-Steel Castings Co., St. Louis; Campbell, Wyant & Cannon Foundry Co., Muskegon, Mich.; Frank Foundries Corp., Davenport, Ia.; Lakey Foundry & Machine Co., Muskegon, Mich.; sand mixers from the National Engineering Co., Chicago.

Shakeout Equipment

Campbell, Wyant & Cannon Foundry Co., Muskegon, Mich.; Studebaker Corp., South Bend, Ind., vibrator and shakeout equipment from the Stoney Foundry Engineering & Equipment Co., Cleveland.

Tumbling Barrels

American Radiator Co., St. Paul, continuous tumbling barrel from the J. W. Paxson Co., Philadelphia.

Pyle-National Co., Chicago, two tumbling barrels from the Whiting Corp. Harvey, Ill.

Miscellaneous

Climax Engineering Co., Clinton, Ia.; Western Steel Foundry Co., Muskegon, Mich., embossing machines from the J. S. McCormick Co., Pittsburgh.

PITTSBURGH MARKET

Furnaces

Reliance Steel Casting Co., Pittsburgh, one annealing oven, from the Mayor Fuel Saving Furnace Co., Cleveland.

Portage Bronze & Electric Co., Portage, Pa., 400-pound brass furnace from the J. S. McCormick Co., Pittsburgh.

Stockham Pipe & Fittings Co., Birmingham, Ala., two cupolas from the Whiting Corp., Harvey, Ill.

Molding Machines

Pittsburgh Valve, Foundry & Construction Co., Pittsburgh, locomotive type sand throwing machine from the Beardsley & Piper Co., Chicago.

Union Steel Casting Co., Pittsburgh, one molding machine; Pittsburgh Malleable Iron Co., Pittsburgh, one molding machine from the Herman Pneumatic Machine Co., Zelienople, Pa.

Miscellaneous

Edgar Thomson Foundries, two motor driven cupola blowers from the J. S. McCormick Co., Pittsburgh.

NEW YORK MARKET

Furnaces

American Radiator Co., Bayonne, N. J., one cupola from the Whiting Corp., Harvey, Ill.

Molding Machines

Kennedy Valve Mfg. Co., Elmira, N. Y., tractor type sand throwing machine; Standard Sanitary Mfg. Co., Baltimore, stationary type sand throwing machine, from the Beardsley & Piper Co., Chicago.

Sandblast Equipment

Josiah Anstice & Co., Inc., Rochester, N. Y., sandblast tumbling barrel from the J. W. Paxson Co., Philadelphia.

Sand Preparing Equipment

Lynchburg Foundry Co., Lynchburg, Va., sand mixer and elevating equipment from the Standard Sand & Machine Co., Cleveland.

CLEVELAND MARKET

Furnaces

Erie Forge Co., Erie, Pa., two core ovens with furnaces; from the Mayor Fuel Saving Furnace Co., Cleveland.

Buick Motor Co., Flint, Mich., six cupolas from the Whiting Corp., Harvey, Ill.

Molding Machines

Dayton Steel Foundry Co., Dayton, O., stationary type sand throwing machine; United Engineering & Foundry Co., Canton, O., motive type sand throwing machine; American Foundry & Machine Co., Hamilton, O., portable type sand throwing machine and hopper; United States Radiator Corp., Detroit, tractor type sand throwing machine from the Beardsley & Piper Co., Chicago.

Southern Wheel Co., Toledo, six molding machines including two rollovers, two bumpers and two strippers; Reibold Heater Co., Ashland, O., three molding machines; Pratt & Letchworth Co., Buffalo, two molding machines, from the Herman Pneumatic Machine Co., Zelienople, Pa.

Sandblast Equipment

Dodge Bros., Detroit, sandblast tumbling barrel from the J. W. Paxson Co., Philadelphia.

Sand Preparing Equipment

Fairbanks Co., Springfield, O., sand mixer from the National Engineering Co., Chicago.

Shakeout Equipment

Holmes Foundry Co., Sarnia, Ont., vibrator and shakeout equipment; O. S. Kelly Co., Springfield, O., shakeout bails, from the Stoney Foundry Engineering & Equipment Co., Cleveland.

Tumbling Barrels

American Radiator Co., continuous tumbling barrels for the Bond plant, Buffalo and the malleable plant, Buffalo, from the J. W. Paxson Co., Philadelphia.

NEW ENGLAND MARKET

Molding Machines

E. L. Le Baron Foundry Co., Brockton, Mass., tractor type sand throwing machine from the Beardsley & Piper Co., Chicago.

Sandblast Equipment

American Hardware Co., New Britain, Conn., sandblast machine from the J. W. Paxson Co., Philadelphia.

What the Foundries Are Doing

Activities of the Gray Iron, Malleable, Steel and Brass Shops

Nonpareil Mfg. Co., Cochranton, Pa., manufacturer of agricultural implements, will rebuild the burned portion of its plant.

Duncan Mackenzie's Sons Co., Trenton, N. J., is having plans made for a foundry 60 x 200 feet at Fernwood, N. J.

Peerless Foundry Co., 1853 Ludlow street, Indianapolis, has awarded a contract for an addition, 67 x 85 feet.

Kilpatrick & Sons Foundry Co., St. Louis, will rebuild the burned portion of its foundry plant.

Menzel & Jeffery Co., Minneapolis, has changed is name to the Jeffrey-Quest Foundry Co.

Ritter Dental Mfg. Co., 404 West avenue, Rochester, N. Y., has let contract to Stallmans Sons, 25 Main street, East Rochester, N. Y., for a 1-story foundry 60 x 140 feet.

Somerville Machine & Foundry Co., 14 Kent street, Somerville, Mass., is taking bids on a 1-story plant 40 x 80 feet from plans by Daniel Cormier, 15 Herbert street, architect.

Power Specialty Co., Dansville, N. Y., Charles H. Reigart superintendent, is considering plans for an addition to be devoted to manufacture of coal pulverizers.

Regent Stove Co., Wyandotte, Mich., is having plans made for a 1-story addition for an enameling plant, and improvements to other structures.

Kalamazoo Stove Co., Kalamazoo, Mich., A. L. Blakeslee general manager, has let contract to R. D. Boyer for a 1-story addition for use as an enameling plant.

Morman Boosey Mfg. Co., Detroit, has been incorporated to manufacture plumbing supplies by E. W. N. Boosey, 5140 Hamilton avenue, Lawrence N. Boosey and Lewis J. Frost.

Syracuse Foundry, Syracuse, N. Y., has been incorporated with $100,000 capital by G. N. Knaus, H. S. Mallery and E. C. Thelen. L. O. Grossman, Syracuse, N. Y., is attorney.

Oakland Motor Car Co., A. R. Clancy president and general manager, Oakland avenue, Pontiac, Mich., has let contract to the Austin Co., Cleveland, for a 1-story foundry 160 x 630 feet, for which plans are being drawn.

George Murad, New York, has been incorporated with $20,000 capital to manufacture metal castings by G. Murad, D. Waldman and R. Golin. H. Bloom, 38 Park Row, is attorney.

Howatt Mfg. Corp., New York, has been incorporated with $150,000 capital to operate a brass and iron foundry by C. Falk and J. H. Noll. C. E. Francis, 150 Nassau street, is attorney.

Waukegan Foundry Co., North Chicago, Ill., has moved into its new plant which is 94 x 254 feet. The foundry occupies a space 60 x 254 feet and the remainder of the building is devoted to machine shop, pattern storage, etc.

Michigan Implement Co., Grand Ledge, Mich., has been incorporated with $60,000 capital to operate a foundry and manufacture agricultural implements by Eugene Andre, E. Allen Dick and Frank Abdre, Grand Ledge, Mich.

Gardner Governor Co., Quincy, Ill., H. Malone purchasing agent, has let general contract to Buerkin & Buerkin, Broadway and Second street, for an addition to its machine shops, one story 53 x 130 feet. Behrensmeyer & Hafner are architects.

Clinton Mfg. Corp., Camden, N. J., has been incorporated with $50,000 capital to manufacture valves by F. R. Hansell, I. C. Clow and John A. McPeak, Camden, N. J. New Jersey Corporation Guarantee & Trust Co., Camden, N. J., is attorney.

Resumption of operations of the Hoosick Foundries Inc., Hoosick Falls, N. Y., will depend upon the results of a meeting of creditors of the company. The plant recently was closed down because of financial difficulties.

The Port Huron Corp. of Illinois has been incorporated at Chicago with a capitalization of $1,000,000 to manufacture farm equipment, implements and machinery. Gerald L. McMullen, 140 North Dearborn street, is correspondent.

It is announced that arrangements have been completed whereby National Steel Castings, Ltd., a new concern, will establish a plant at Campbellford, Ont., to manufacture steel and alloy castings by the electric furnace process.

Kitson Machine Shop, Lowell, Mass., has been incorporated with 1000 shares no par value to manufacture machinery and tools by Henry R. Guild president, Ocean street, Nahant, Mass., Francis H. Cummings treasurer, 9 Joy street, Boston, and Robert Cutler. (Noted Dec. 15.)

Olson-Kehl Co., 546 West Washington street, Chicago, has been incorporated with $40,000 capital to manufacture water heaters, plumbing and heating supplies by Henry J. Viemann, Milton Baldock and Henry P. Etheredge. Henry Perlman, 140 North Dearborn street, room 1304, is correspondent.

An option for the purchase of the controlling interest of the Marion Steam Shovel Co., Marion, O., has been obtained by Blair & Co., New York investment bankers. The opition will expire Feb. 10, 1927, according to the announcement of President Frank A. Huber, of the Marion company. The manufacturing property is estimated to be worth $5,000,000.

Receiver for the Warren Foundry Co., Warren, O., in the person of George C. Braden was named by common pleas court on Dec. 21. The Western Reserve National bank of Warren, trustee for $200,000 bonds issued by the foundry company less than a year ago started the action. The bonds carry 7 per cent interest and failure of the company to pay the first coupons precipitated action.

Pulaski Foundry & Mfg. Corp., Pulaski, Va., recently purchased the tools and equipment of the Dora Foundry from the Virginia Iron, Coal & Coke Co., that city. To accommodate the extra equipment, the Pulaski Foundry & Mfg. Corp. is making extensions which include a new blacksmith's shop and a new pattern shop. Jay J. Seaver, 2422 Euclid avenue, Cleveland, is president of the company.

The plant of the American Malleable Co. at Lancaster, Pa., was damaged to the extent of close to $500,000 by a fire of undetermined origin. The foundry, roundhouse and several other buildings were saved but some of the principal production departments were destroyed. The company had recently installed machinery valued at $100,000 for experimental production of new type automobile brakes. Insurance covers the loss.

Stowell Co., South Milwaukee, Wis., malleable castings and hardware, lost part of its plant by fire Dec. 4, necessitating suspension of operations. It is not known if the plant will be rebuilt, as it has been in charge of creditors for more than a year, with Fred L. Sivyer, president of the Northwestern Malleable Iron Co., Milwaukee, as trustee. Virtually all of the equipment and machinery was wrecked by heat and water, and the buildings, including the main foundry, badly damaged. The plant is one of the oldest malleable foundries in the Middle West.

William Cramp & Son Ship & Engine Building Co., which is controlled by the American Ship & Commerce Corp., is to segregate the properties operated by its I. P. Morris Co. department. This nonmarine department will be organized into the I. P. Morris Corp. and controlled by a holding company. It is also proposed to transfer to this holding company stocks owned by the De La Vergne Machine Co., Pelton Water Wheel Co., and Federal Steel Foundry Co. Stockholders will meet Dec. 29 to act on the proposals. The I. P. Morris properties are used for the construction of hydroelectric machinery and are said to be the most profitable unit in the Cramp group.

Lake Superior Steel Foundry Co. poured its first heat of steel castings on Dec. 1 at its new foundry at West Duluth, Minn. The plant is equipped throughout with the most modern equipment for the production of high quality steel castings exclusively. Mr. Durwechter, the general superintendent, has had 28 years of steel foundry experience, while Mr. Stanley, the furnace superintendent, has had 25 years experience. The officers of the new company are: President, D. C. Bakewell, also president of the Duquesne Steel Foundry Co., Pittsburgh; vice president, E. C. Congdon; treasurer, Ward Ames Jr.; secretary and manager, A. A. Bakewell formerly president of the Bakewell Co., Joliet, Ill.

R. D. Eaglesfield Inc., Brazil, Ind., manufacturers of woodworking machinery which recently was thrown into the hands of a receiver has been sold in federal bankrupt court at Indianapolis to the Marion Machine, Foundry & Supply Co., Marion, Ind. Officials of the Marion company immediately organized a new company to be known as the Indiana Machine & Foundry Co., which was incorporated with $100,000 capital stock to take over the business. The new company began putting the plant in condition for operation. About $25,000 will be spent at once installing an iron and brass foundry in the west wing where all castings are made. R. D. Eaglesfield, who will remain with the new company, is the owner of patents on many special woodworking machines. Lack of working capital was given as the cause of the sale. The new owners plan enlargements.

New Trade Publications

TURBO COMPRESSORS AND BLOWERS—A descriptive circular covering its compressors and blowers has been issued by the American Brown Boveri Electric Corp., New York. It covers the general subject of blowing and compression, regulation, and then describes the construction and operation of its types for various uses. The illustrations are complete and diagrams and charts serve further to illustrate the text.